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NATIONAL DAM INSPECTION PROGRAM. J. C. BACON DAM (NDI I.D. NUMB--ETC(U)
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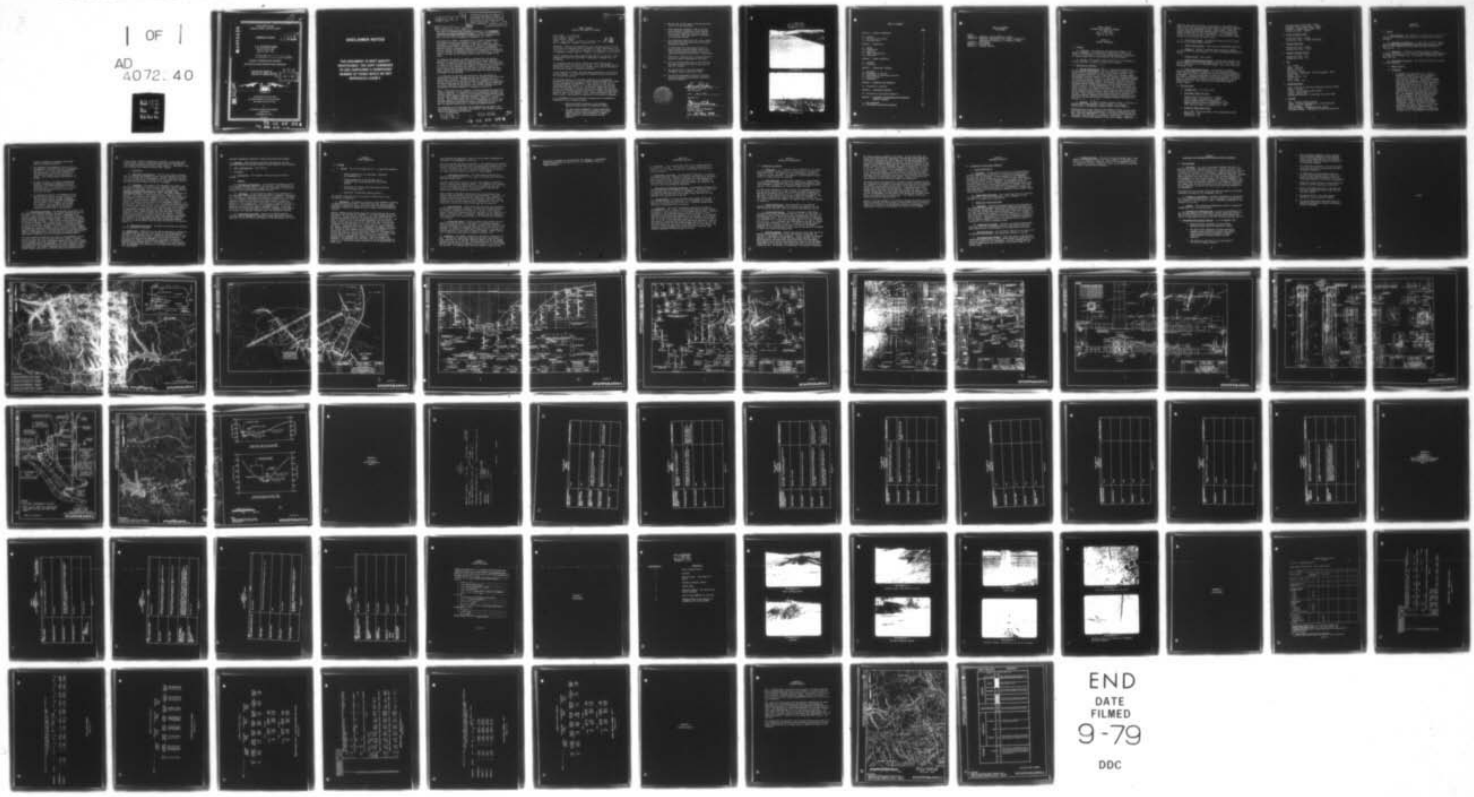

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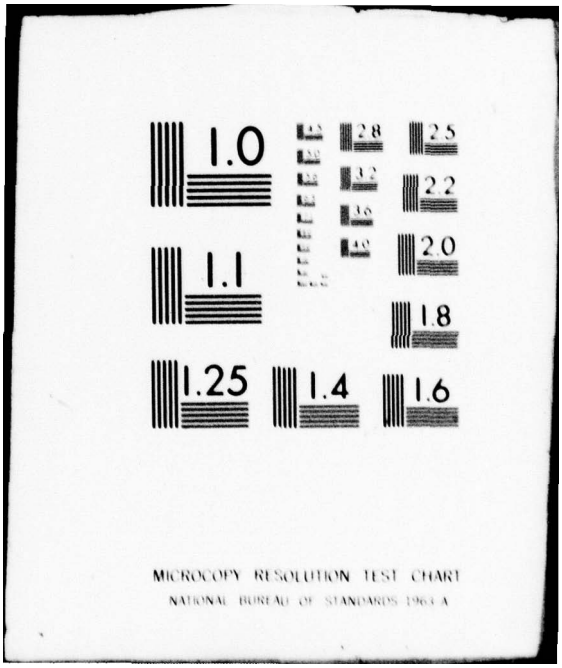
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OHIO RIVER BASIN
SERVICE CREEK, BEAVER COUNTY

PENNSYLVANIA

J.C. BACON DAM

NDI I.D. NO:PA-260
DER I.D. NO: 4-42

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235

MAY 1979

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(11) May 79

(6) National Dam Inspection Program. J. C. Bacon Dam (NDI I.D. Number PA-260, DER I.D. Number 4-42), Ohio River Basin, Service Creek, Beaver County, Pennsylvania. Phase I Inspection Report.

(15) DACW31-79-C-0014

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigation and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: J. C. Bacon Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Beaver
STREAM: Service Creek, a tributary of Raccoon Creek
DATE OF INSPECTION: December 14 and 20, 1978

ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observations, the condition of J. C. Bacon Dam is assessed to be unsafe due to the seriously inadequate spillway capacity. However, the condition is nonemergency.

Numerous seepage points were observed below the toe of the dam. These seepage points should be monitored to determine if seepage flows are increasing.

It is reported that the outlet conduit sluice gate has not been operated since the construction of the dam. It is recommended that the operational condition of the outlet conduit sluice gate be immediately assessed and necessary maintenance performed.

It was observed that debris and brush have accumulated at the spillway approach channel. This area should be cleared to avoid obstruction of flow through the spillway.

The spillway capacity was evaluated according to the recommended procedure and was found to pass 40 percent probable maximum flood (PMF) without overtopping the embankment. This capacity is less than the recommended spillway capacity of full PMF according to the size and hazard classification of the dam. Furthermore, because the spillway capacity is less than 50 percent PMF and it was judged that failure of the dam due to overtopping would significantly increase the downstream hazard of loss of life compared to that hazard which would exist just before failure, the spillway is considered to be seriously inadequate.

It is recommended that the following recommendations be implemented immediately or on a continuing basis:

1. Debris and brush accumulated in the spillway approach channel should be immediately cleared.

2. The owner should immediately initiate additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity.

3. The low spot on the crest of the dam should be filled to design elevation.

4. Flow monitoring equipment, such as overflow weirs, should be installed at major seepage points at the downstream toe of the dam and data obtained should be regularly evaluated by a professional engineer.

5. The operational condition of the outlet conduit sluice gate should be evaluated and necessary maintenance performed.

6. An around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system developed to alert the downstream residents in the event of emergencies.

7. Ponded water along the toe of the dam should be drained to permit inspection of this area.

8. Brush on the downstream slope of the dam near the right abutment and trees on the rock toe should be cleared.

9. The erosion ditch at the right abutment embankment junction should be filled.

10. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

Lawrence D. Andersen, P.E.
Vice President

Date: May 3, 1979

Approved By:

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE: 20 May 1979

J. C. BACON DAM
NDI I.D. NO. PA-260
DECEMBER 14, 1978

Upstream Face

Downstream Face

TABLE OF CONTENTS

TABLE OF CONTENTS
(CONTINUED)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
J. C. BACON DAM
NDI I.D. NO. PA-260
DER I.D. NO. 4-42

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

ABSTRACT

a. Dam and Appurtenances. The J. C. Bacon Dam consists of an earth embankment approximately 1000 feet long with a maximum height of 95 feet from the downstream toe and a crest width of 15 feet. The flood discharge facilities for the dam consist of a combined primary and emergency spillway located on the left abutment (looking downstream). The spillway structures consist of a trapezoidal earth approach channel, a 115-foot-long concrete overflow section, and a partially concrete-lined spillway discharge channel. The concrete lining in the spillway discharge channel extends approximately 230 feet downstream from the control section to a level approximately 37 feet above the normal pool level of the dam. The outlet works consist of a 5-foot by 5-foot reinforced concrete outlet conduit, a 24-inch cast-iron water supply line, and a reinforced concrete control tower located on the upstream side of the dam. Flows through the outlet conduit and supply line are controlled by manually operated sluice gates located in the control tower. This outlet system constitutes the emergency drawdown facilities for the dam.

ABSTRACT

b. Location. The dam is located on Service Creek, a tributary of Raccoon Creek, approximately 4 miles southwest of Aliquippa, Pennsylvania, in Independence Township, Beaver County (Plate 1).

Downstream from the dam, Service Creek meanders through a narrow valley and joins Raccoon Creek approximately 1-1/2 miles downstream from the dam. There are approximately 8 homes in the Service Creek valley which are likely to be affected in the event of a dam failure. Below the confluence, Raccoon Creek generally flows north through a 2000-foot to

3000-foot wide valley for about 2 miles where it flows under State Route 60 and then flows near the western edge of the town of Aliquippa. It then turns west meandering through a narrow valley. There are numerous houses and one major shopping center in the Raccoon Creek valley upstream from the Route 60 underpass. It is estimated that failure of the dam would cause large loss of life and property damage in Service Creek and Raccoon Creek valleys.

c. Size Classification. Intermediate (based on 95-foot height and 15,100 acre-feet storage capacity).

d. Hazard Classification. High (based on downstream conditions).

e. Ownership. Borough of Ambridge Water Authority (address: Mr. Walter Saiko, Borough Engineer, P.O. Box 220, Ambridge, Pennsylvania 15003).

f. Purpose of Dam. Water supply.

g. Design and Construction History. The dam was designed by The Chester Engineers of Pittsburgh, Pennsylvania from 1953 to 1955. The dam was constructed by D. W. Winkelman Company, Inc., with completion in November 1956.

h. Normal Operating Procedure. The reservoir is normally maintained at Elevation 935, the level of the uncontrolled spillway crest, leaving 10 feet of freeboard to the top of dam at Elevation 945 as designed. Inflow occurring when the lake is at or above the spillway level is discharged through the uncontrolled spillway. The supply water is received from the intake tower and discharged through the 24-inch supply line. The low-level outlet works sluice gate is normally closed.

1.3 Pertinent Data

a. Drainage Area - 15.7 square miles

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - Unknown
Outlet conduit at maximum pool - Unknown
Gated spillway capacity at maximum pool - N/A
Ungated spillway capacity at maximum pool - 9300
Total spillway capacity at maximum pool - 9300

c. Elevation (USGS Datum) (feet)

Top of dam - 945 (as designed); 943.8 (measured low spot)
Maximum pool - 945
Normal pool - 935

Upstream invert outlet works - 855.25
Downstream invert outlet works - 850.19
Streambed at center line of dam - 850+
Maximum tailwater - Unknown

d. Reservoir Length (feet)

Normal pool level - 14,000
Maximum pool level - 15,000 (estimated)

e. Storage (acre-feet)

Normal pool level - 10,863
Maximum pool level - 15,100

f. Reservoir Surface (acres)

Normal pool level - 418
Maximum pool level - 432

g. Dam

Type - Earth
Length - 1000 feet
Height - 95 feet
Top width - 15 feet
Side slopes - Downstream: 2.5H:1V; Upstream: 3H:1V
Zoning - Yes
Impervious core - Yes
Cutoff - Yes
Grout curtain - Yes

h. Regulating Outlet

Type - Five-foot by five-foot reinforced concrete conduit
Length - 537 feet
Closure - Sluice gate at control tower
Access - Control tower
Regulating facilities - Sluice gate at control tower

i. Spillway

Type - Concrete overflow section
Length - 115 feet (perpendicular to flow direction)
Crest elevation - 935 feet
Upstream channel - Trapezoidal earth channel
Downstream channel - Trapezoidal concrete spillway chute

SECTION 2
DESIGN DATA

2.1 Design

a. Data Available. The available information was provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER).

(1) Hydrology and Hydraulics. A state report entitled, Report Upon the Application of Borough of Ambridge Water Authority, dated April 7, 1955, summarizes the available hydrology and hydraulic information.

(2) Embankment. Available information consists of design drawings, specifications, and subsurface investigation report prepared by Foundation Associates, Inc., of Pittsburgh, Pennsylvania, dated March 28, 1955.

(3) Appurtenant Structures. The available information consists of design drawings.

b. Design Features

(1) Embankment

a. As designed, the dam (Plate 2) is a zoned embankment consisting of a central impervious core section with upstream and downstream shell sections (Plate 3). The internal drainage system for the embankment consists of a 2-foot-thick sand and gravel filter blanket beneath the downstream slope starting at a point about 100 feet downstream from the axis of the dam and terminating at the rock toe. The rock toe is located beneath a 50-foot-wide berm at a level about 25 feet above the downstream toe of the dam. The embankment materials were designated as Class A material for the impervious core section and Class B and Class C materials beneath the upstream and downstream slopes, respectively. These materials were described as follows: Class A - 50 percent clay and 50 percent soft shale; Class B - not less than 30 percent clay and the remainder shale; Class C - any material which is not classified as Class A or B. The embankment materials were

further classified as inorganic silty clays with low to medium plasticity.

b. The embankment was designed to have a 2.5 to 1 (horizontal to vertical) slope on the downstream face and a 3 to 1 slope on the upstream face. The upstream face of the dam is protected by concrete blocks placed on a 6-inch layer of gravel. This paving extends from Elevation 925 to 940.

c. As shown on Plate 4, at least 45 borings were drilled to investigate foundation and borrow materials. The subsurface profile is illustrated in Plate 3. It consists of 5 to 10 feet of overburden underlain by soft brown sandy shale and sandstone.

d. As indicated in Plate 3, the foundation of the dam was grouted through a single line of grout holes along the axis of the dam, extending from the right abutment through the embankment and the crest of the spillway. Grout holes were drilled 5 feet on centers and extended to a depth of approximately 20 feet at the valley floor and 30 feet on the abutments.

(2) Appurtenant Structures. The appurtenant structures of the dam consist of a combined emergency and primary spillway and the outlet works. The spillway structures include a trapezoidal earth approach channel, concrete overflow section, and partially concrete-lined trapezoidal spillway discharge channel. The spillway plan and profile are shown in Plate 5. The 115-foot concrete overflow section is located at Elevation 935, leaving 10 feet of freeboard as designed to the top of the dam. The approach channel is an unlined channel excavated into the left abutment. The bottom of the approach channel as designed is located at Elevation 933.4, leaving a 1.5-foot approach depth at normal pool level. The paved section of the spillway discharge channel is approximately 230 feet long from the overflow section to a point where it empties into an earth channel at Elevation 887.2.

The outlet works are located at the center of the embankment and consist of a 5-foot by 5-foot reinforced concrete conduit, a 24-inch cast-iron supply line, and a reinforced concrete control tower located on the upstream side of the embankment. The outlet conduit is equipped with trash racks at the upstream end and an outlet structure at the downstream end. The conduit is equipped with four reinforced concrete cutoff collars located over a 220-foot distance downstream from the

control tower. Plate 6 illustrates the details of the outlet works. Flows through the outlet conduit and supply line are controlled by sluice gates located in the control tower (Plate 7). The control tower also includes three high-level supply water intakes.

c. Design Data

(1) Hydrology and Hydraulics. The 1955 state report indicates that the spillway was designed to pass "expected maximum flow of 8900 cfs" with a freeboard of approximately one foot. The report implies that the spillway capacity provided was in conformance with the spillway design criteria used at the time of the design.

(2) Embankment. The design of the embankment was based on the subsurface investigation and geotechnical engineer's report prepared by Foundation Associates, Inc., of Pittsburgh, Pennsylvania, entitled, Borough of Ambridge Water Authority, Service Creek Dam, Soils Investigation Report, dated March 28, 1955. The report indicates that laboratory soil tests included classification, compaction, shear strength, consolidation, and permeability tests. The borrow materials were generally classified as inorganic silty clays of low to medium plasticity. Modified Proctor compaction tests were performed to determine compaction characteristics of the embankment materials. The optimum water content was reported to be 13 percent and Modified Proctor dry densities were reported to be in the range of 122 to 128 pounds per cubic foot (pcf). It is reported that shear strength tests consisted of consolidated undrained quick direct shear tests and unconfined compression tests. Shear strength tests were performed on samples compacted to 95 percent of Modified Proctor dry density. The report further indicates that a stability analysis was conducted considering the stability of the upstream slope under rapid drawdown conditions and stability of the downstream slope under steady-state seepage. The factor of safety against slope failures was reported to be approximately 1.5.

(3) Appurtenant Structures. No design calculations are available for the appurtenant structures.

2.2 Construction. Construction of the dam was apparently conducted in conformance with the drawings, specifications, and recommendations included in the engineer's report. Construction progress reports indicate that no unusual construction difficulties were encountered. The specifications required the embankment to be placed in layers not exceeding four inches in loose depth and compacted to 95 percent of Modified Proctor maximum density. Field density test results indicate that the embankment was constructed in conformance with the specification requirements.

Available information indicates no major postconstruction changes.

2.3 Operation. Water authority personnel reported that the only operating records for the dam consist of daily reservoir level readings.

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. The available information was provided by PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. The available information consists of the design discharge capacity of the spillway. This information is not considered to be adequate to assess the conformance of the spillway capacity to the current spillway design criteria.

(2) Embankment. The dam design was based on the evaluation of the subsurface conditions and borrow materials by Foundation Associates, Inc. The extent of subsurface and materials investigation is considered to be in reasonable conformance with currently accepted practice. The engineer's report did not include sufficient details to assess the adequacy of the procedure used. Nevertheless, the reported factor of safety of 1.5 is considered to be in a reasonable range for the type of materials involved and the range of embankment slopes. It was also noted that the design incorporated such basic components as an impervious central core, internal drainage system, and foundation grouting.

(3) Appurtenant Structures. Review of the design drawings indicates that as designed no significant design deficiencies existed that would affect the overall performance of the appurtenant structures.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of J. C. Bacon Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the spillway and its components and the downstream end of the outlet conduit.

3. Observation of factors affecting runoff potential of the drainage basin.

4. Evaluation of downstream hazard potential.

The specific observations are illustrated in Plate 8 and in the photographs in Appendix C.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

Numerous seepage points and wet areas were found below the toe of the dam and on the right and left abutments. Two major seepage points were identified. One is located at the toe level of the dam on the left abutment approximately 50 feet downstream from the toe of the dam. The other is located on the right abutment embankment interface approximately 20 feet upstream from the toe level of the dam. Flows in both seepage points were estimated to be on the order of 40 to 50 gallons per minute. Discharges were clear, indicating that seepage flows are not causing internal erosion of the embankment or foundation materials. The location of other seepage points discharging approximate 4 to 5 gallons per minute or less is identified on Plate 8. The swampy areas on the right and left abutments were found to be located mostly on the natural ground of the abutments and only partially reaching the junction of the embankment and abutments. While no seepage flow appeared to be associated with the swampy area on the left abutment, a flow of 4 to 5 gallons per minute was found to be discharging from the swampy area.

This discharge has apparently caused an erosion ditch extending from midheight of the embankment to the toe.

The top of the dam was surveyed relative to the spillway crest elevation and was found to be generally below the design crest elevation with some vertical irregularities. While the design freeboard for the dam was 10 feet, the survey indicated freeboards ranging from 8.8 to 9.8 feet. The lowest area occurred at the center of the embankment.

c. Appurtenant Structures. The appurtenant structures were examined for deterioration or other signs of distress and obstructions that would limit flow.

The most significant condition noted was the presence of brush and debris in the spillway approach channel. This condition is considered to pose a potential for obstruction of flow through the spillway. The rocks at the downstream end of the outlet conduit constitute an obstruction of flow through the outlet works.

Water authority personnel reported that the access bridge to the control tower had partially collapsed and was removed. Therefore, the control tower was not accessible for inspection. Water authority personnel also reported that, to their knowledge, the outlet conduit sluice gate has not been operated since construction of the dam. The operation of the outlet conduit sluice gate was not observed.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered by woodlands. Several rural residential areas are scattered throughout the watershed. A review of the regional geology (Appendix E) indicates that the shorelines of the reservoir are likely to be susceptible to landslides. However, massive landslides which would affect the storage volume of the reservoir are considered to be unlikely.

e. Downstream Channel. Brush and debris approximately 500 feet downstream from the toe of the dam appear to be causing backwater, which is submerging the toe of the dam. Although this condition is not considered to affect the discharge capacity of the outlet works or the spillway, the presence of ponded water along the toe of the dam precluded inspection of this area for signs of seepage. Further description of downstream conditions is included in Section 1.2b.

3.2 Evaluation. The overall condition of the dam is considered to be fair. The two most significant conditions noted are the presence of brush and debris in the spillway approach channel and the two seepage points below the toe of the dam. The brush and debris in the spillway approach channel should be removed to avoid obstruction of flow through the spillway. The seepage areas should be regularly inspected and

monitored to document if the conditions are changing. A preliminary survey indicated that the crest of the dam is generally below the design elevation.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. It is reported that there are no formal operating procedures for the dam. The reservoir is normally maintained at the spillway crest level with excess inflow discharging over the uncontrolled spillway.

4.2 Maintenance of the Dam. The maintenance condition of the dam is considered to be fair. Although it appears that portions of the embankment are annually mowed, there is brush near the right abutment and large trees on the rock toe below the bench level. The presence of brush and debris in the spillway approach channel also indicates that the dam is not being adequately maintained.

4.3 Maintenance of Operating Facilities. As previously discussed, the control tower was not accessible for inspection. Therefore, maintenance of operating facilities could not be assessed. Water authority personnel reported that the outlet conduit sluice gate has not been operated since construction of the dam.

4.4 Warning System. No formal warning system exists for the dam. A water authority employee responsible for the operation of the pump house at the dam site resides at the site. Telephone communication facilities are available at his residence.

4.5 Evaluation. The overall maintenance condition of the dam is considered to be fair. Debris in the spillway approach channel should be removed to avoid obstruction of flow through the spillway. Similarly, the debris in the downstream channel should be cleared to permit draining the pond along the downstream toe of the dam. It is reported that the outlet works sluice gate has not been operated since construction of the dam. The operational condition of the outlet works sluice gate should be evaluated and necessary maintenance performed. Brush on the downstream slope near the right abutment and trees on the rock toe should be cleared to facilitate closer inspection of these areas. The low spots on the embankment and the erosion ditch along the right abutment embankment interface should be filled.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. J. C. Bacon Dam has a watershed of 15.7 square miles and impounds a reservoir with a surface area of 420 acres at normal pool level. The combined primary and emergency spillway is located on the left abutment. The capacity of the spillway is determined to be 9300 cfs with no freeboard.

b. Experience Data. As previously stated, J. C. Bacon Dam is classified as an intermediate dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass full PMF.

The PMF inflow hydrograph for the reservoir was determined utilizing the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army, Corps of Engineers. Data used for the computer analysis are presented in Appendix D. The PMF inflow hydrograph was found to have a peak flow of 38,204 cfs. The computer input and the summary of computer output are also included in Appendix D.

c. Visual Observations. Brush and debris in the spillway approach channel are considered to constitute an obstruction to the flow through the spillway, partially reducing the spillway capacity.

d. Overtopping Potential. Various percentages of PMF inflow hydrograph were routed through the reservoir and it was found that the spillway can pass 40 percent PMF without overtopping the low spot on the embankment crest. For 50 percent PMF, the dam would be overtopped for a duration of 3.2 hours with a maximum depth of 1.0 foot if failure did not occur. It is estimated that overtopping of the dam by 6 inches would initiate breaching of the dam. A further overtopping analysis assuming that the low spot on the crest is filled to the design elevation of 945 indicated that in this case the dam would be overtopped by about 0.15 foot for 50 percent PMF.

e. Spillway Adequacy. Because the spillway cannot pass the recommended spillway design flood of full PMF without overtopping, the spillway is classified to be inadequate. Further, because the spillway capacity is less than 50 percent PMF and a breach analysis, which is described below, indicates that failure resulting from overtopping would significantly increase the potential for loss of life and damage downstream from the dam over that which would exist just before overtopping failure, the spillway is classified to be seriously inadequate.

The breach analysis consisted of two steps. In the first step, the inflow that would initiate breaching of the dam was routed through the reservoir to determine the flood stages in the potential damage area just before overtopping failure of the dam. In the second step, flood stages in the potential damage area were determined by routing the same inflow combined with the discharge that would be contributed by failure of the dam. Flood stages were then compared to determine if the loss of life or damage potential would significantly increase due to failure of the dam by overtopping. For the purpose of isolating and conservatively estimating downstream affects of flow from the dam site alone, discharge from the tributaries of Service Creek downstream from the dam were neglected in determining flood stages. Plate 9 illustrates the cross sections at which the flood stages were determined.

The breach analysis incorporated in the HEC-1 computer program requires the estimation of the depth of overtopping that would initiate breaching, the geometry of the breach and the time it would take for the breach to reach a specified depth after initiation. A trapezoidal breach was assumed with a base width of 300 feet and a depth of 90 feet. It was further assumed that the breach would initiate when the observed low spot on the embankment is overtopped by six inches and the breach would reach its ultimate size in one-half hour. The computer outputs for breach analysis are labeled as Step 2.

Review of the flood stages in the potential damage area before and after failure indicates that flood stages in Service Creek would be raised by about 30 to 35 feet due to dam failure, and this is considered to be a significant increase in the potential for loss of life or damage.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, field observations revealed numerous seeps along the toe of the dam and swampy areas on the right and left abutments at about midheight of the embankment. Although some concern exists as to the effect of these conditions on the overall integrity of the embankment, at the present time, they are not considered to be serious. However, the embankment should be regularly inspected by a professional engineer and seepage flows should be monitored to document that conditions are not changing to an extent that would cause structural distress to the embankment. Further, the pond along the toe of the dam should be drained to permit closer inspection of this area.

(2) Appurtenant Structures. The control tower was not accessible for inspection. Structural performance of the components of the spillway is considered to be satisfactory.

b. Design and Construction Data

(1) Embankment. The dam was designed based on the evaluation of the foundation and embankment materials by Foundation Associates, Inc., of Pittsburgh, Pennsylvania. The design incorporated field and laboratory tests and seepage and stability analyses. The factor of safety for slope stability was reported to be approximately 1.5. However, the report did not include sufficient details or calculations to confirm this conclusion. Nevertheless, for the type of materials involved and for the range of embankment slopes, the reported factor of safety is considered to be within a reasonable range.

(2) Appurtenant Structures. Review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. There have been no reported post-construction modifications to the original design that would affect the structural stability of the embankment. The only reported post-construction modification was the removal of the access bridge to the control tower.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on preliminary analysis, the static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structure is presumed to present no hazard from earthquakes.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations indicate that the J. C. Bacon Dam is in fair condition structurally. However, in view of the seriously inadequate spillway capacity, the overall condition of the dam is assessed to be unsafe, but nonemergency. Numerous seeps along the toe of the dam and two wet areas on each abutment were observed. Although these conditions raise some concern as to the continued integrity of the embankment, at their present extent, they are not considered to be serious relative to the overall performance of the dam. However, these conditions should be regularly evaluated by a professional engineer and the seepage flows should be mointored to document that the conditions are not changing to an extent that would cause structural distress to the embankment.

The capacity of the spillway (40 percent PMF) was found to be seriously inadequate according to the recommended criteria.

b. Adequacy of Information. Available information in conjunction with visual observations and the previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the condition of the dam.

c. Urgency. The following recommendations should be implemented immediately or on a continuing basis.

d. Necessity for Additional Data. In view of the inadequacy of the spillway capacity, the owner should initiate additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide sufficient spillway capacity.

7.2 Recommendations/Remedial Measures. It is recommended that:

1. Debris and brush accumulated in the spillway approach channel should be immediately cleared.

2. The owner should immediately initiate additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide adequate spillway capacity.

3. The low spot on the crest of the dam should be be filled to design elevation.

4. Flow monitoring equipment, such as overflow weirs, should be installed at major seepage points at the downstream toe of the dam and data obtained should be regularly evaluated by a professional engineer.

5. The operational condition of the outlet conduit sluice gate should be evaluated and necessary maintenance performed.

6. An around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system developed to alert the downstream residents in the event of emergencies.

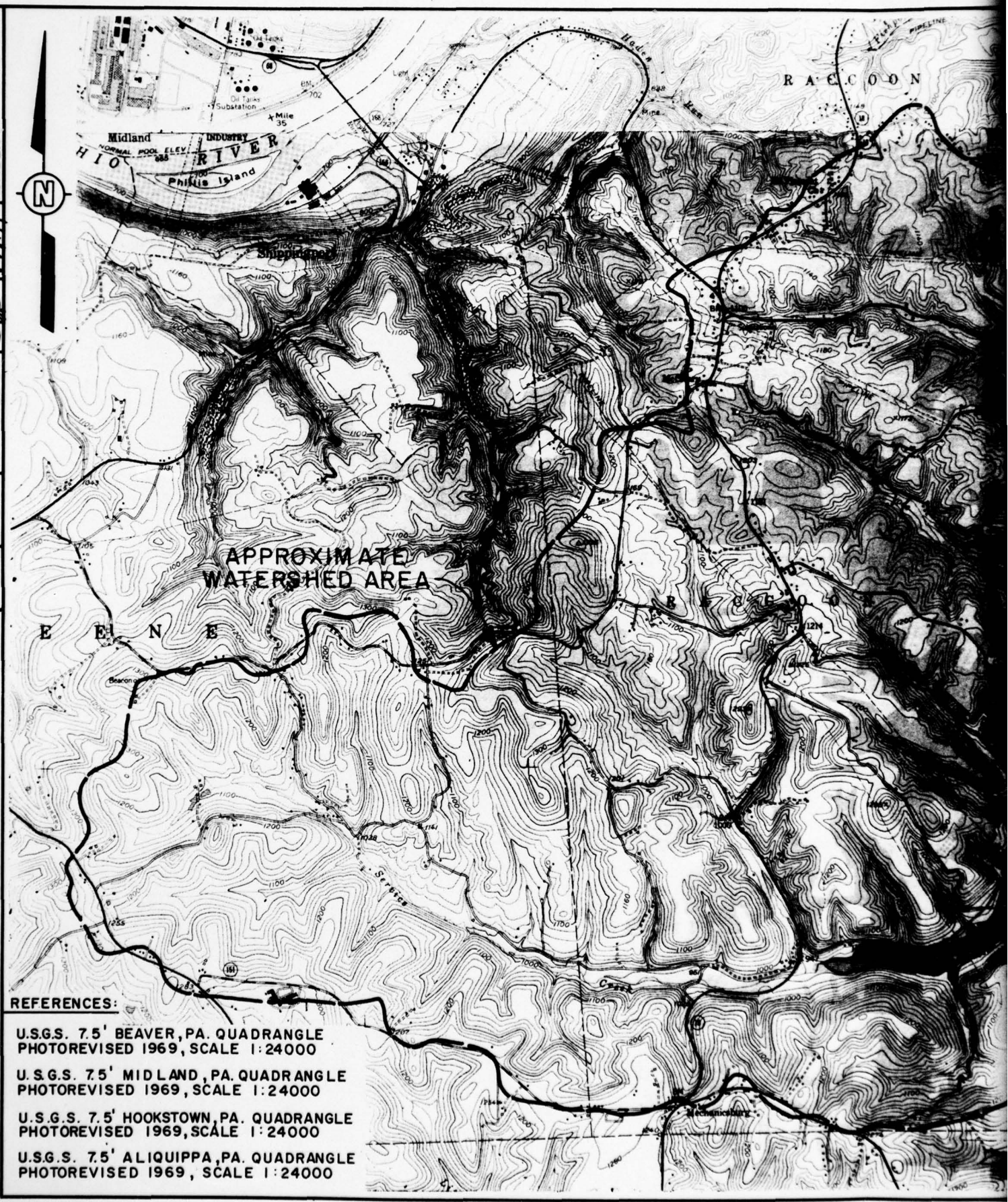
7. Ponded water along the toe of the dam should be drained to permit inspection of this area.

8. Brush on the downstream slope of the dam near the right abutment and trees on the rock toe should be cleared.

9. The erosion ditch at the right abutment embankment junction should be filled.

10. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

PLATES



DRAWN BY	ACS	CHECKED BY	RE	4-17-79	DRAWING NUMBER	78-367-B 104
	1-9-79	APPROVED BY	JMD	4.17.79		

REFERENCES:

U.S.G.S. 7.5' BEAVER, PA. QUADRANGLE
PHOTOREVISED 1969, SCALE 1:24000

U.S.G.S. 7.5' MIDLAND, PA. QUADRANGLE
PHOTOREVISED 1969, SCALE 1:24000

U.S.G.S. 7.5' HOOKSTOWN, PA. QUADRANGLE
PHOTOREVISED 1969, SCALE 1:24000

U.S.G.S. 7.5' ALIQUIPPA, PA. QUADRANGLE
PHOTOREVISED 1969, SCALE 1:24000

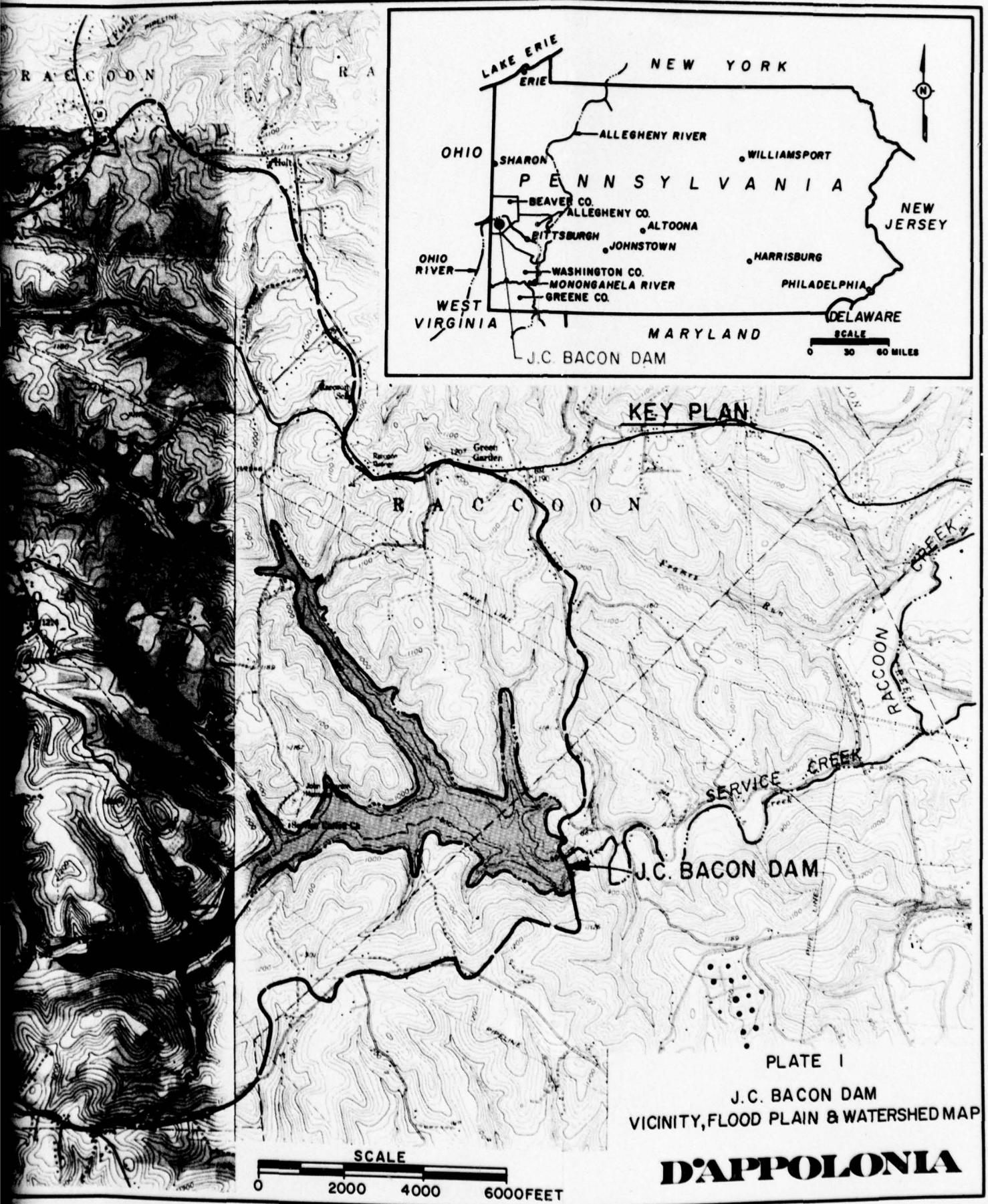


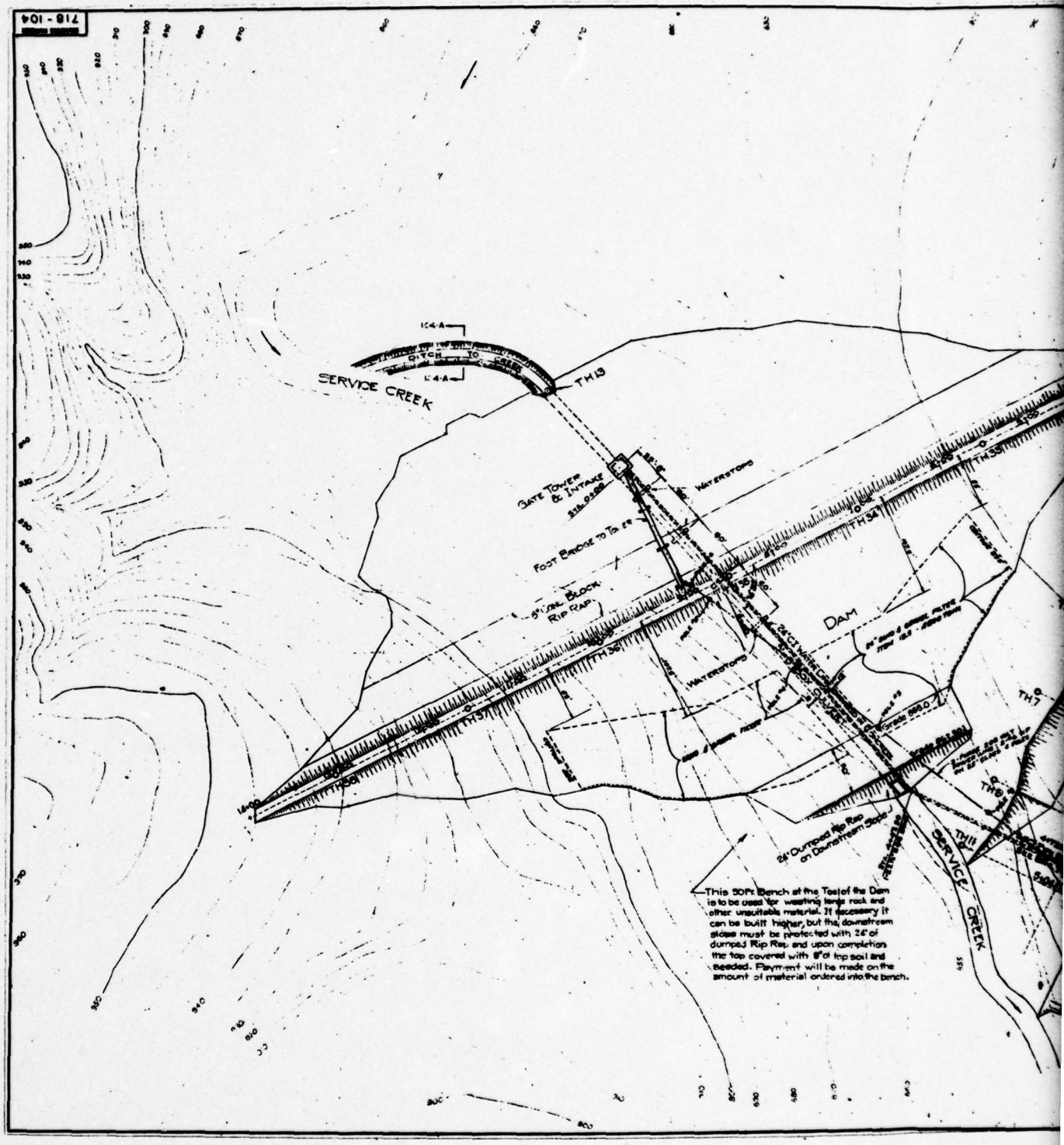
PLATE I

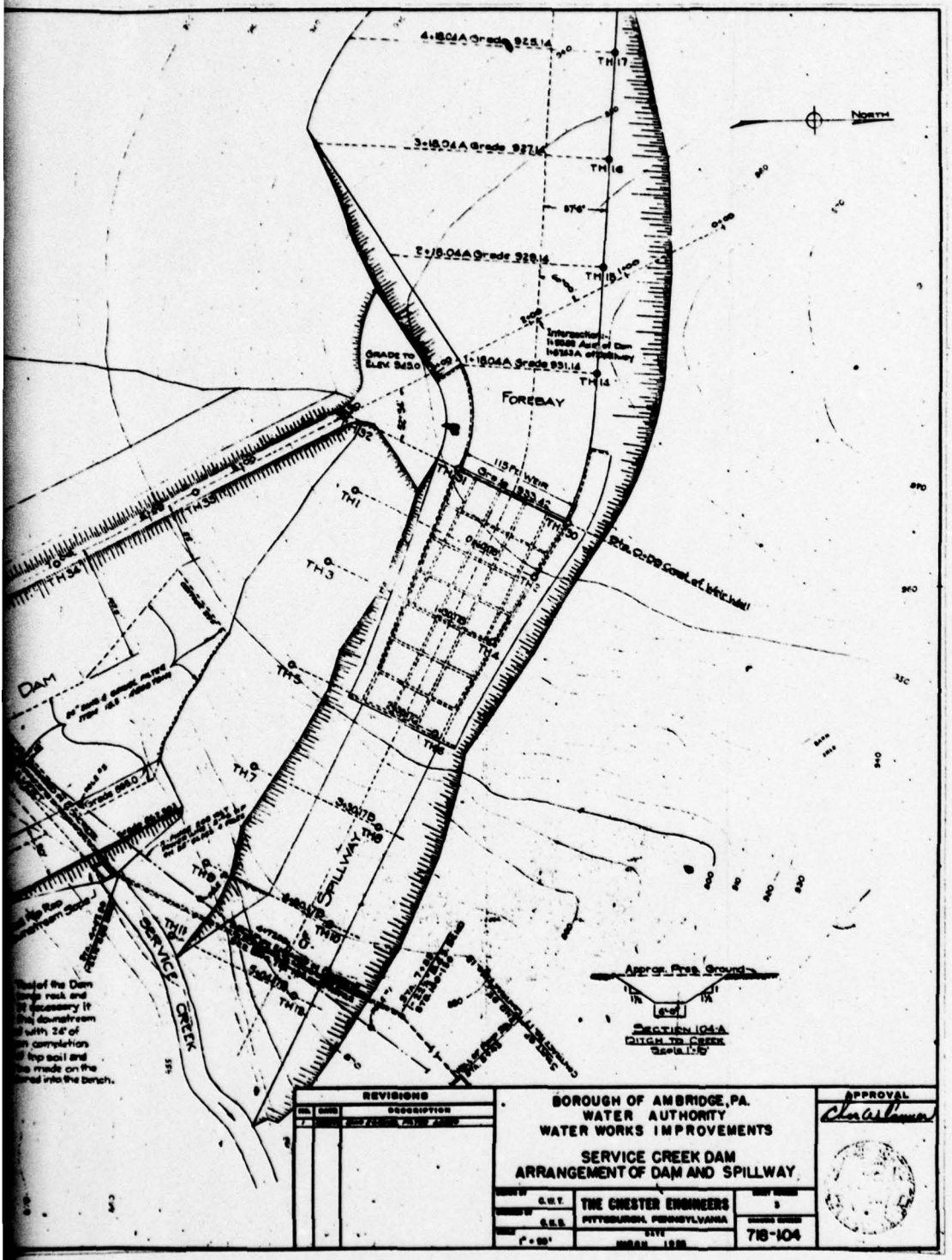
J.C. BACON DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP

D'APPOLONIA

2

DRAWN BY	ACS	CHECKED BY	BE	4-12-79	DRAWING NUMBER	78-367-B105
	1-9-79	APPROVED BY	[illegible]	4-17-79		





2

PLATE 2

D'APPOLONIA

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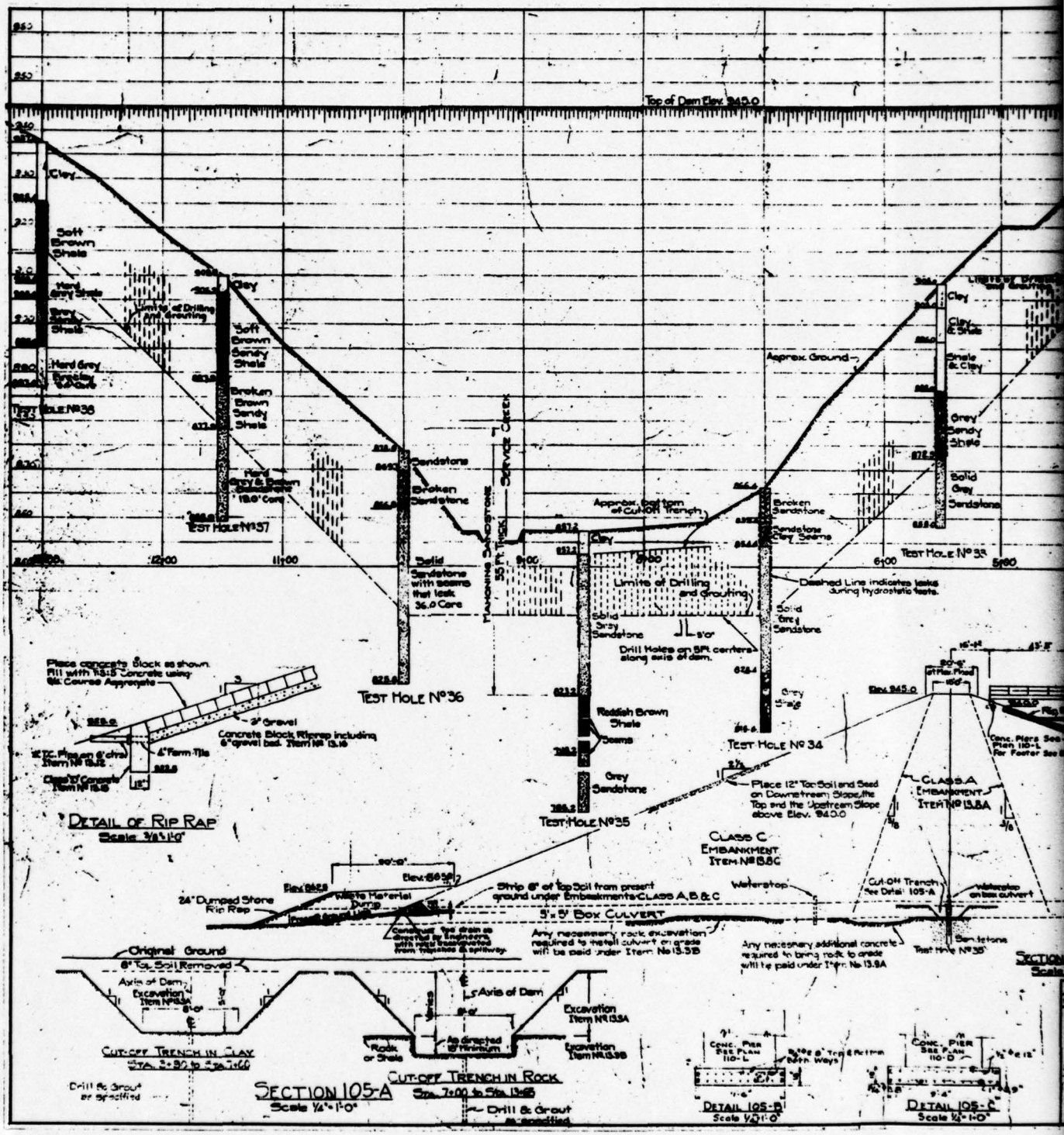
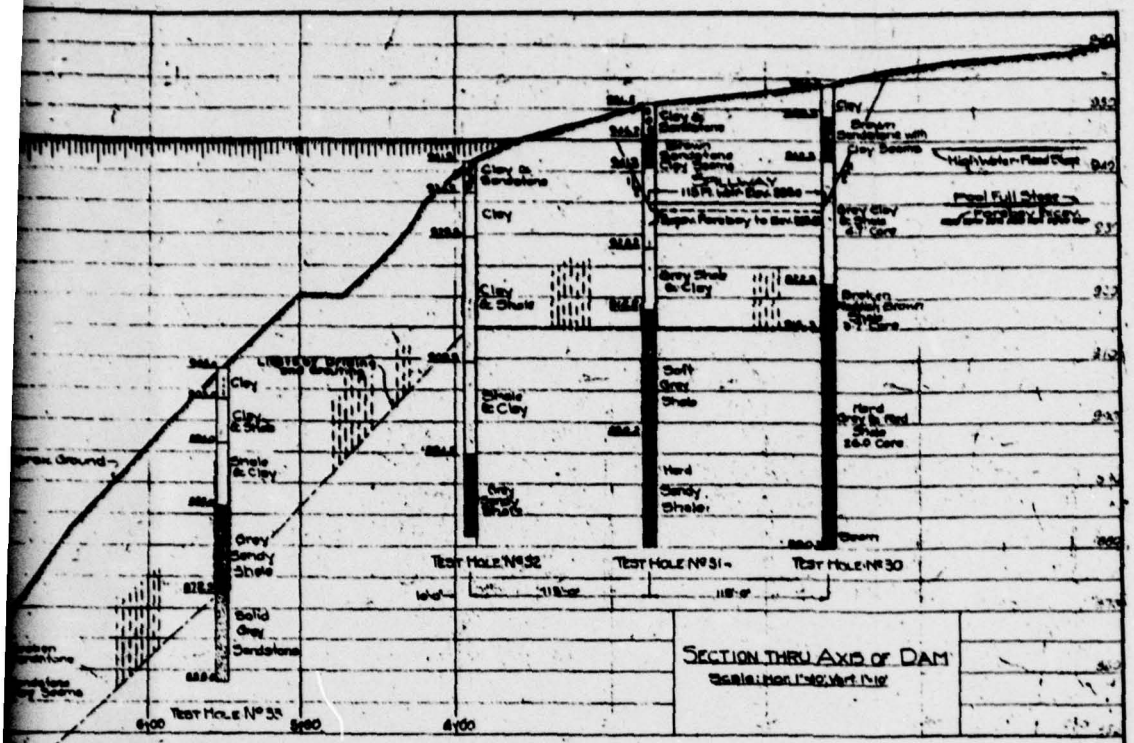
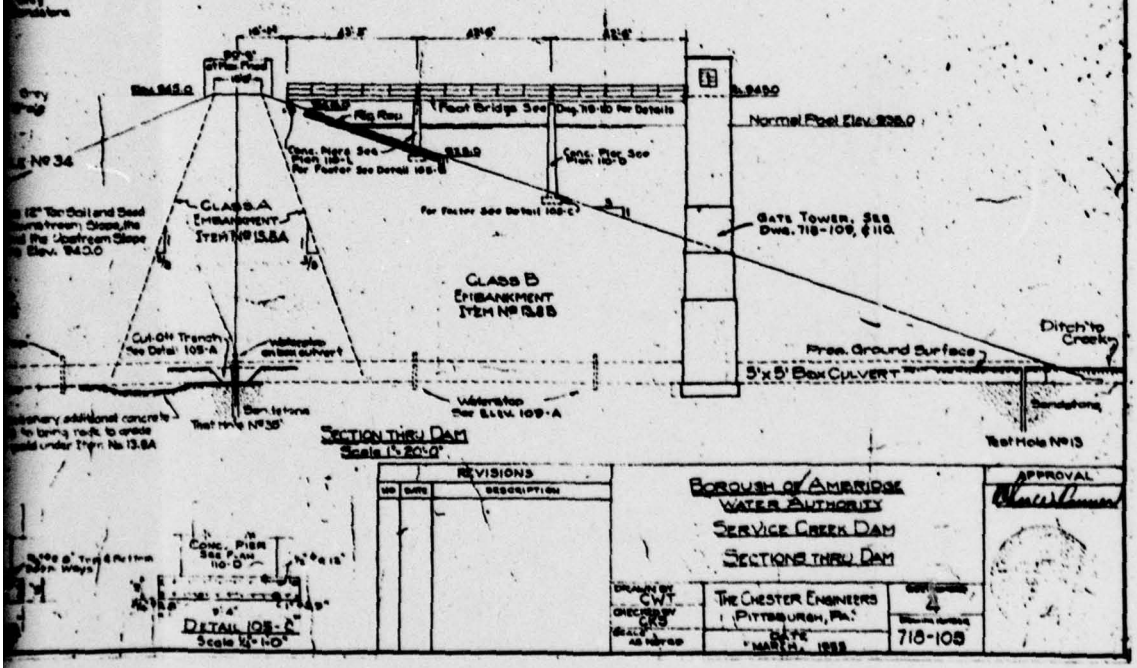
	1-9-79	APPROVED BY	[illegible]	4-17-79	78-367-B106





SECTION THRU AXIS OF DAM

Scale: Hori. 1"=40' Vert 1"=10'



SECTION THRU DAM

Scale 1"=20'-0"

DETAIL 109-A

Scale 1/2"=1'0"

REVISIONS		
NO	DATE	DESCRIPTION

BOROUGH OF AMBRIDGE
WATER AUTHORITY
SERVICE CREEK DAM
SECTIONS THRU DAM

APPROVAL

DRAWN BY CWT	THE CHESTER ENGINEERS PITTSBURGH, PA.	SHEET NUMBER 4	
CHECKED BY CRS	DATE MARCH 1958	DRAWING NUMBER 718-105	

2

PLATE 3

D'APPOLONIA

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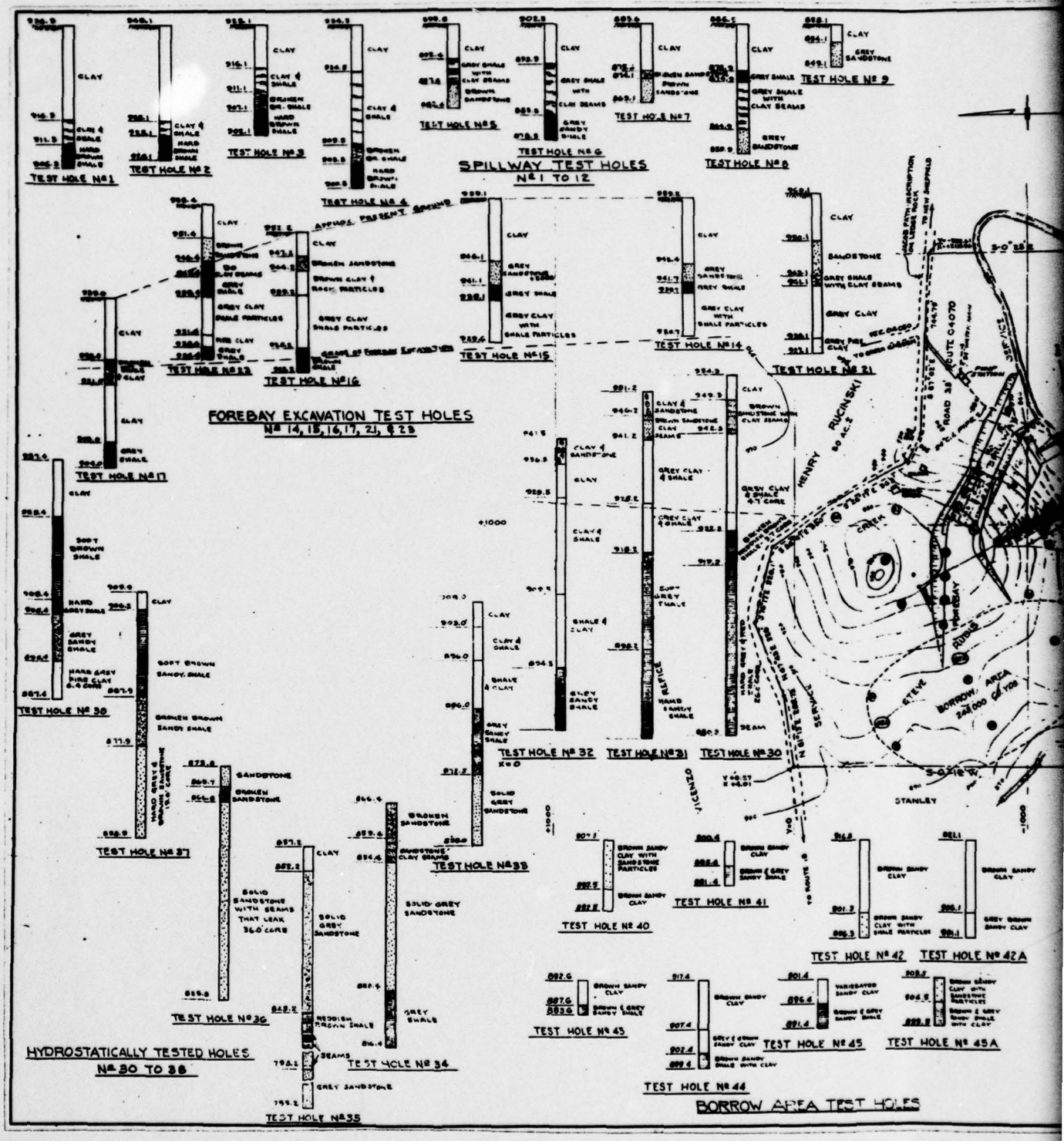
	1-9-79	APPROVED BY	[illegible] 4-17-79		



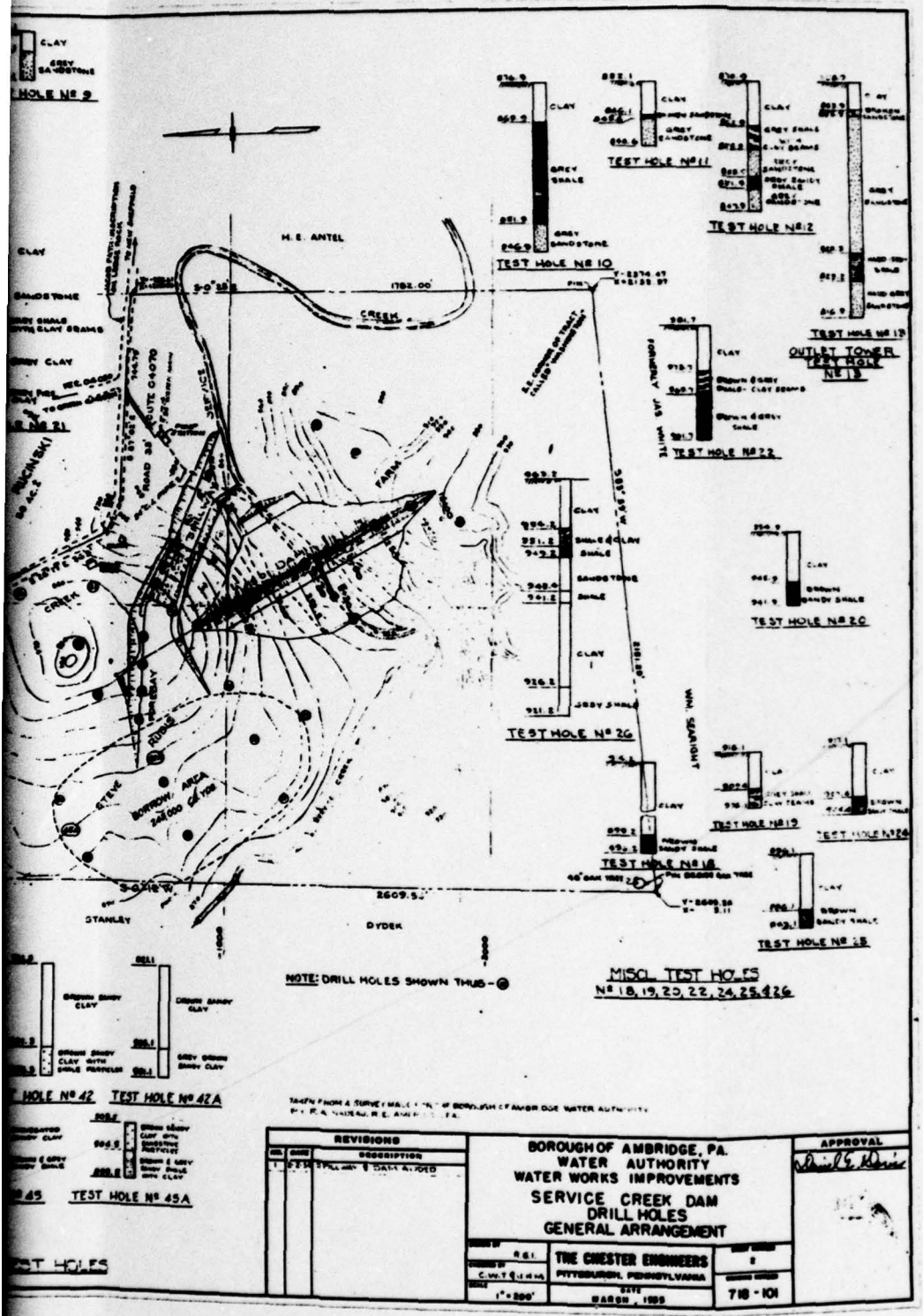


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PLATE 4

D'APPOLONIA

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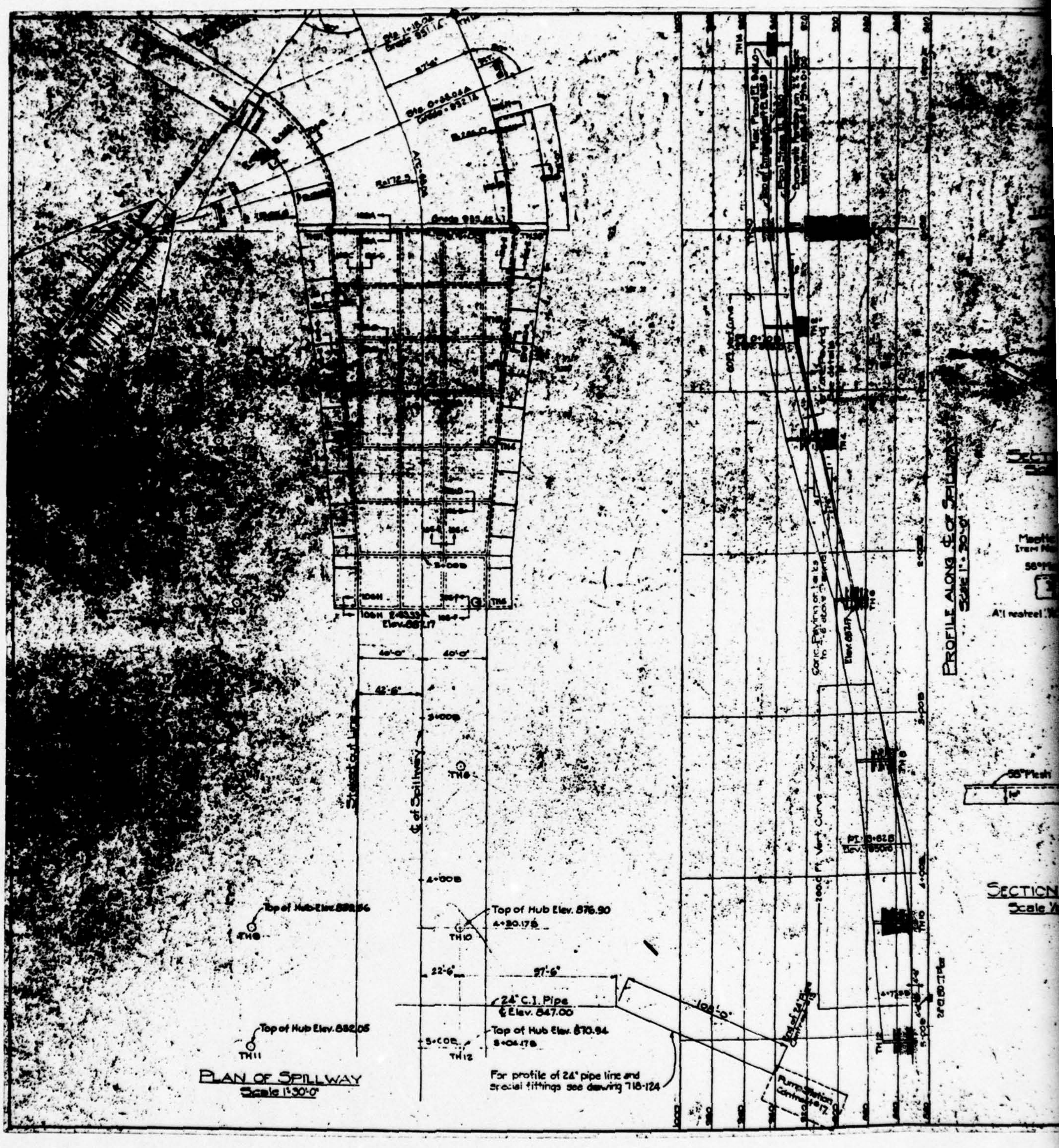
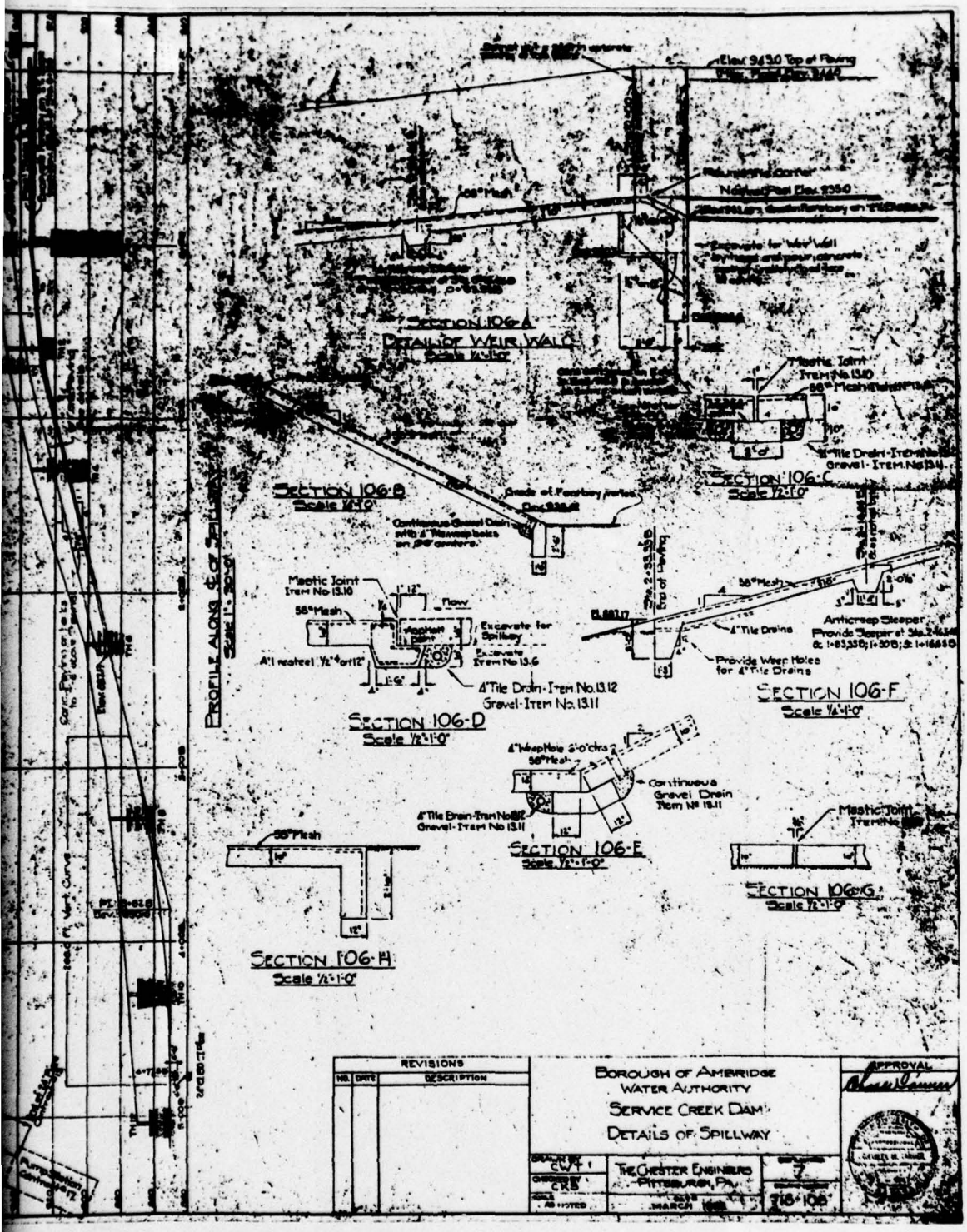
	ACS	APPROVED BY	[illegible]	4-17-79	





REVISIONS		
NO.	DATE	DESCRIPTION

BOROUGH OF AMERIDGE
WATER AUTHORITY
SERVICE CREEK DAM
DETAILS OF SPILLWAY

APPROVAL

DRAWN BY C.W.F.
CHECKED C.R.B.
SCALE AS NOTED
THE CHESTER ENGINEERS PITTSBURGH, PA.
DATE MARCH 1978
DRAWING NO. 7
18-108

2

PLATE 5

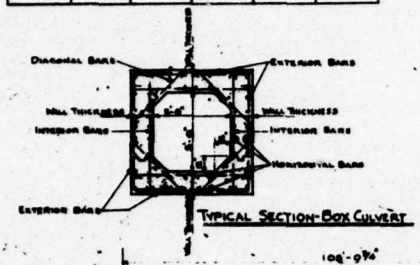
D'APPOLONIA

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
ACS 1-9-79	BE 4-17-79	4-17-79	78-367-B109

601 - 812

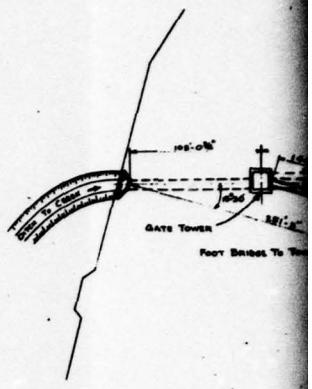
BOX CULVERT REINF. SCHEDULE 109-D

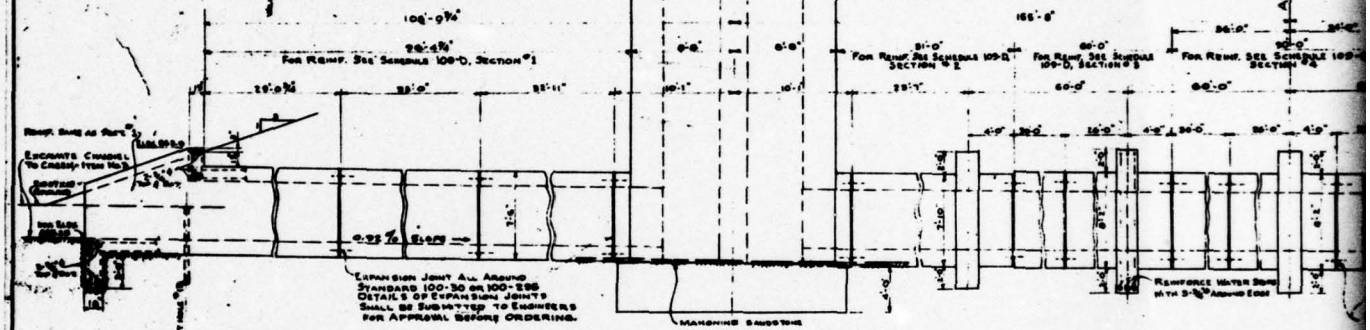
SECTION	WALL THICKNESS	EXTERIOR BARS	INTERIOR BARS	DIAGONAL BARS	HORIZONTAL BARS
#1	18"	#6 @ 7"	#6 @ 9"	#5 @ 9"	#5 @ 11"
#2	17"	#6 @ 7"	#6 @ 8"	#5 @ 8"	#5 @ 9"
#3	15"	#6 @ 7"	#6 @ 7"	#5 @ 7"	#5 @ 12"
#4	15"	#5 @ 6"	#5 @ 6"	#5 @ 6"	#5 @ 12"
#5	17"	#6 @ 7"	#6 @ 8"	#5 @ 7"	#5 @ 9"
#6	15"	#6 @ 8"	#6 @ 9"	#5 @ 9"	#5 @ 11"
#7	15"	#6 @ 9"	#6 @ 9"	#5 @ 9"	#5 @ 11"



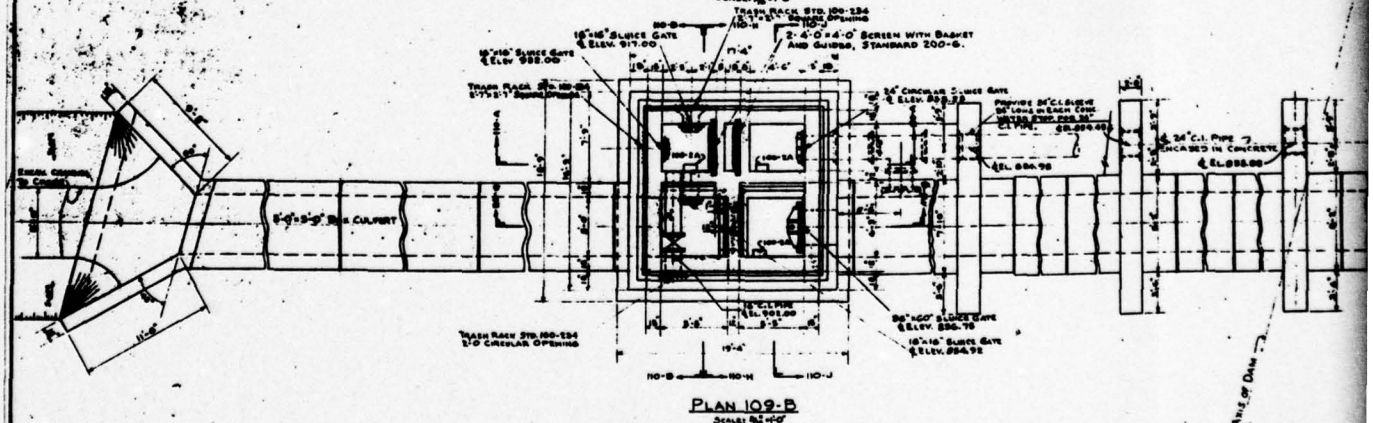
TYPICAL SECTION-BOX CULVERT

GATE TOWER
SEE DWG. 718-110 FOR DETAILS



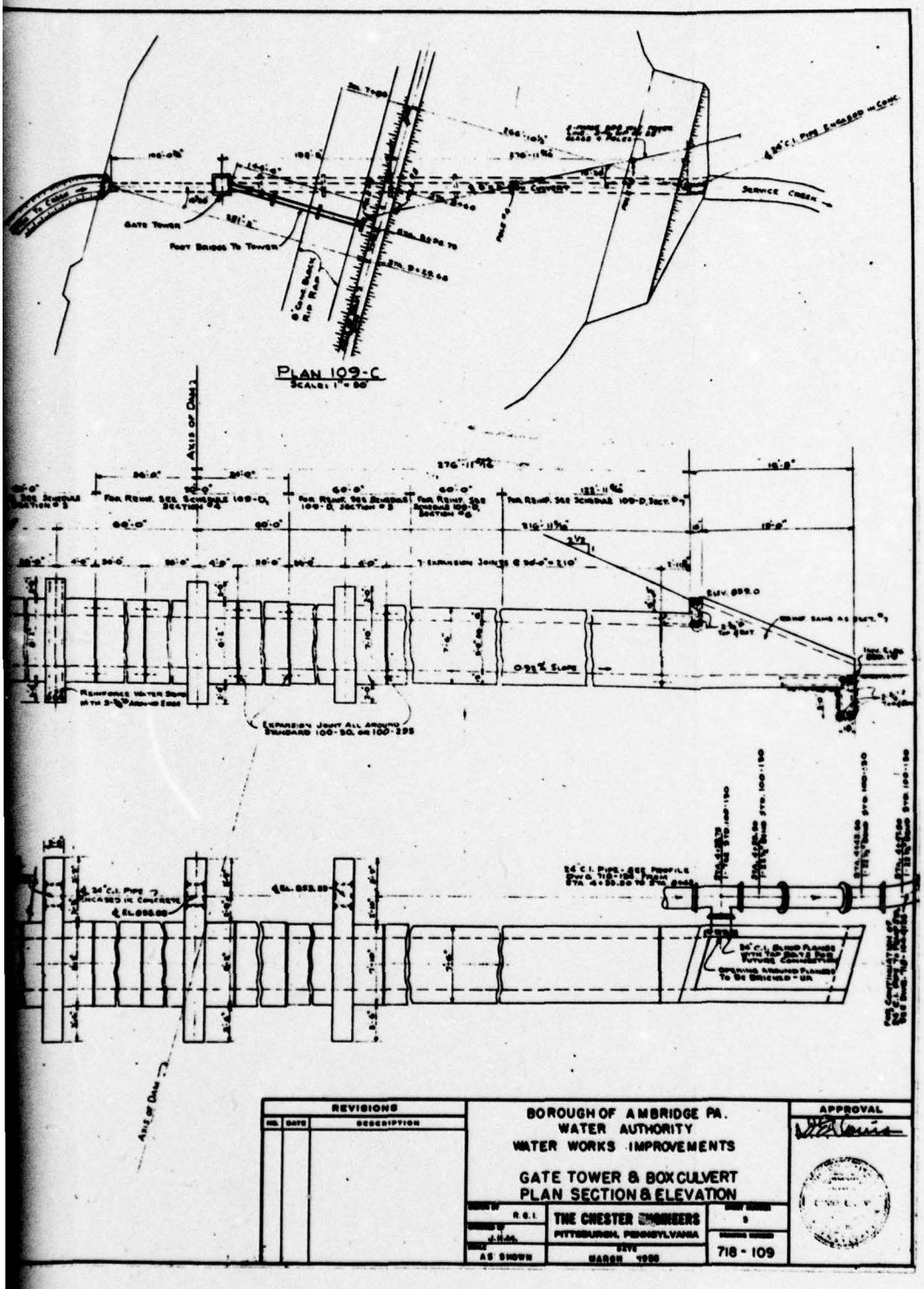


ELEVATION 109-A
SCALE: 1"=10'



PLAN 109-B
SCALE: 1"=10'

1

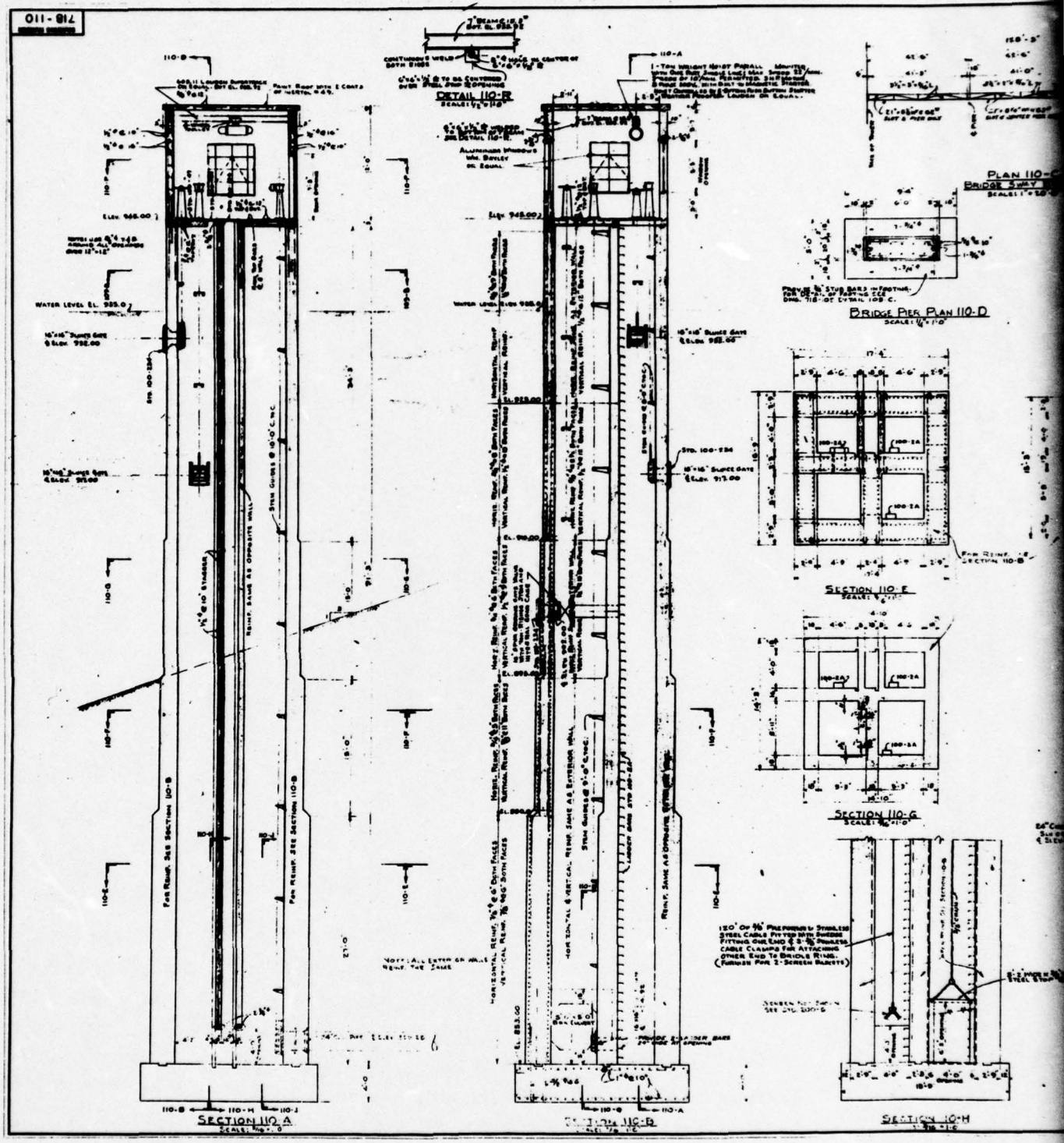


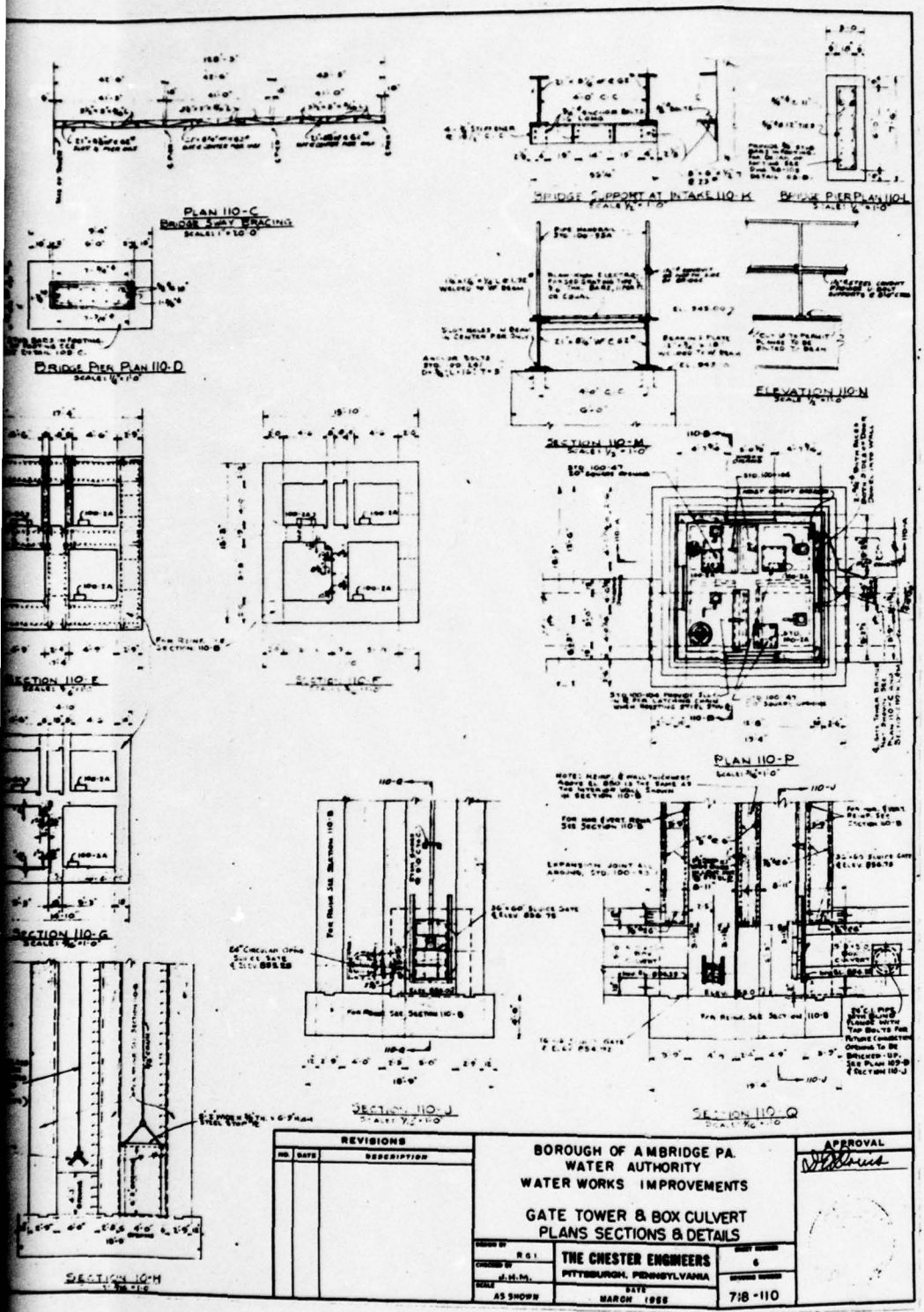
2

PLATE 6

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	AE	4-17-79	DRAWING NUMBER 78-367-B110
	1-9-79	APPROVED BY	[illegible]	4.17.79	

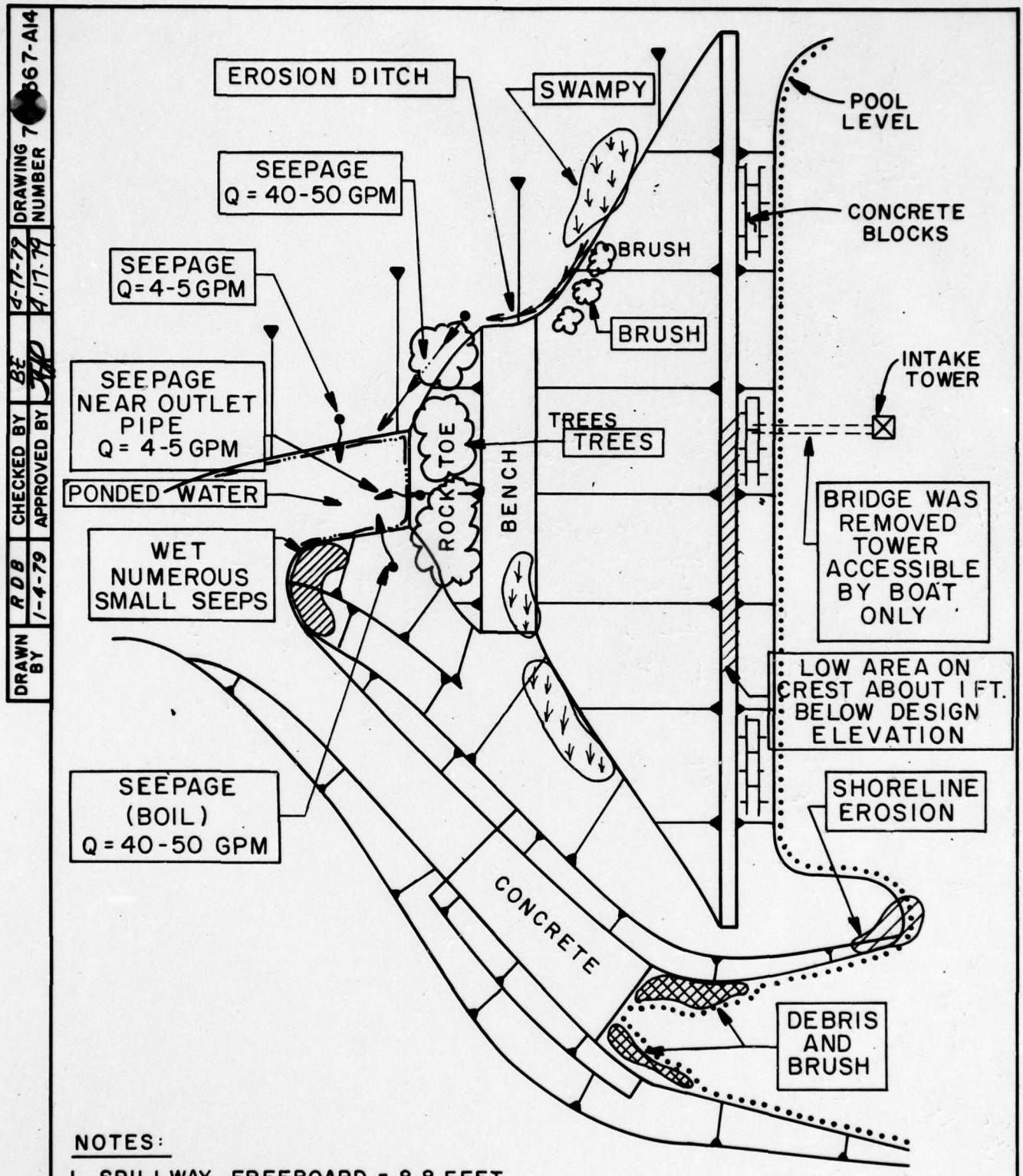




2

PLATE 7

D'APPOLONIA



DRAWN BY RDB 1-4-79
CHECKED BY BE 4-17-79
APPROVED BY [signature] 4.17.79
DRAWING NUMBER 7 867-A14

NOTES:

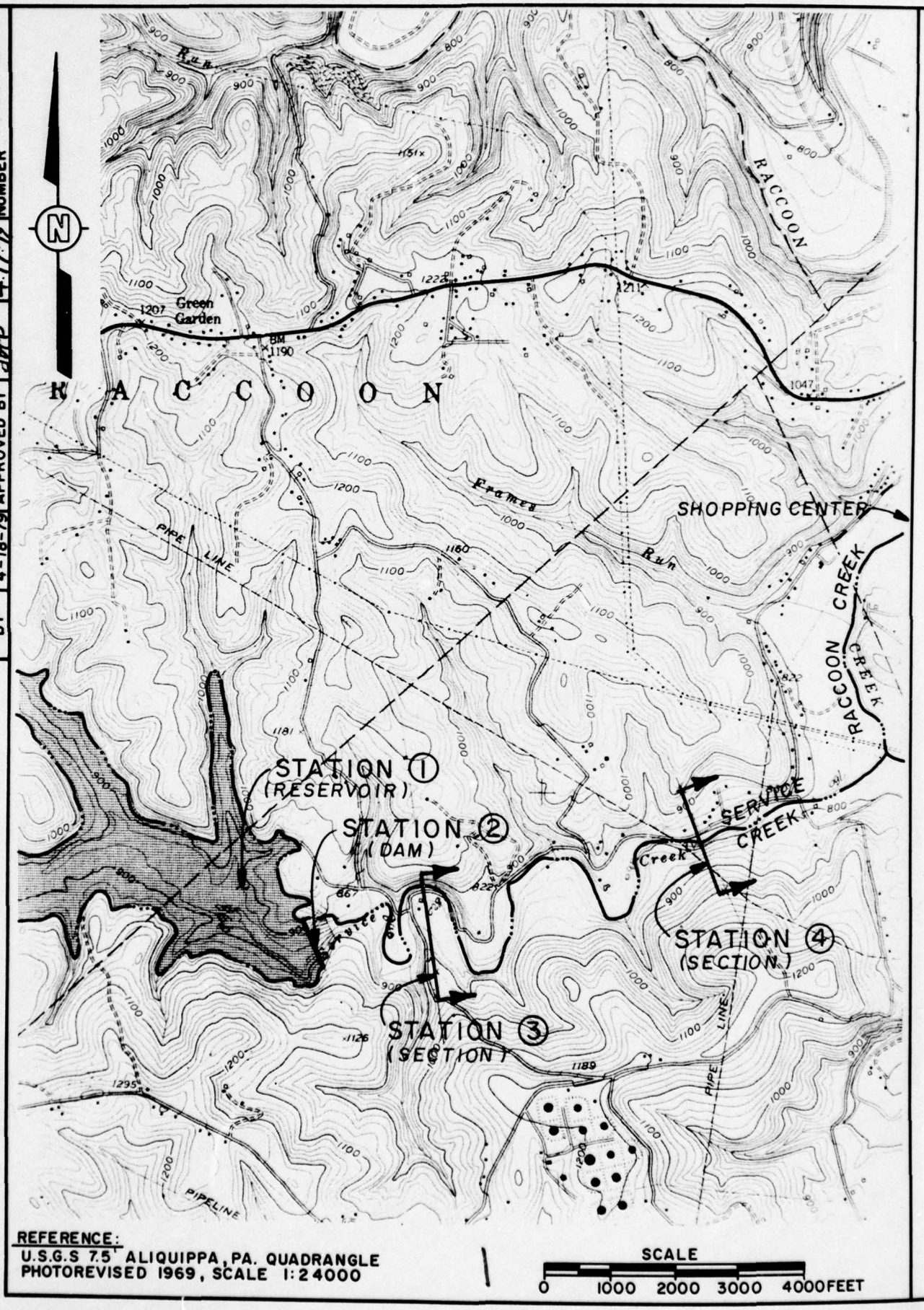
1. SPILLWAY FREEBOARD = 8.8 FEET
2. POOL LEVEL DATE OF INSPECTION: 8.6 FEET BELOW LOW AREA DAM CREST.

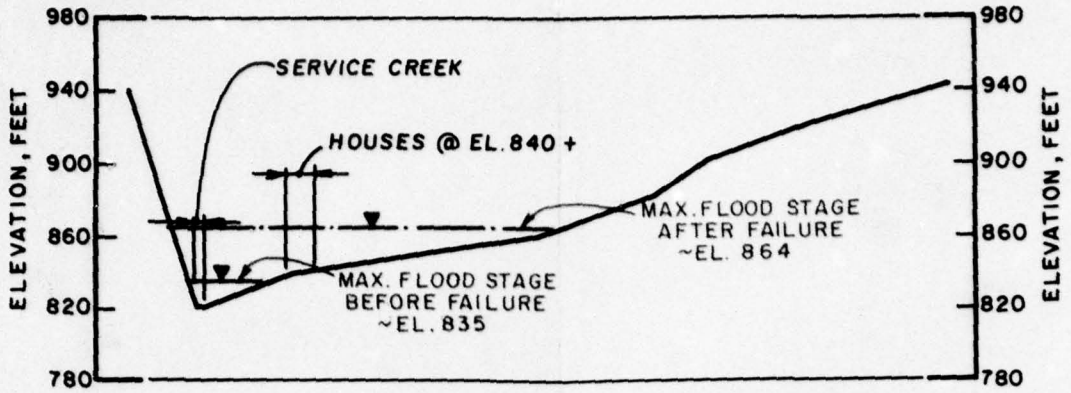
NOT TO SCALE

PLATE 8

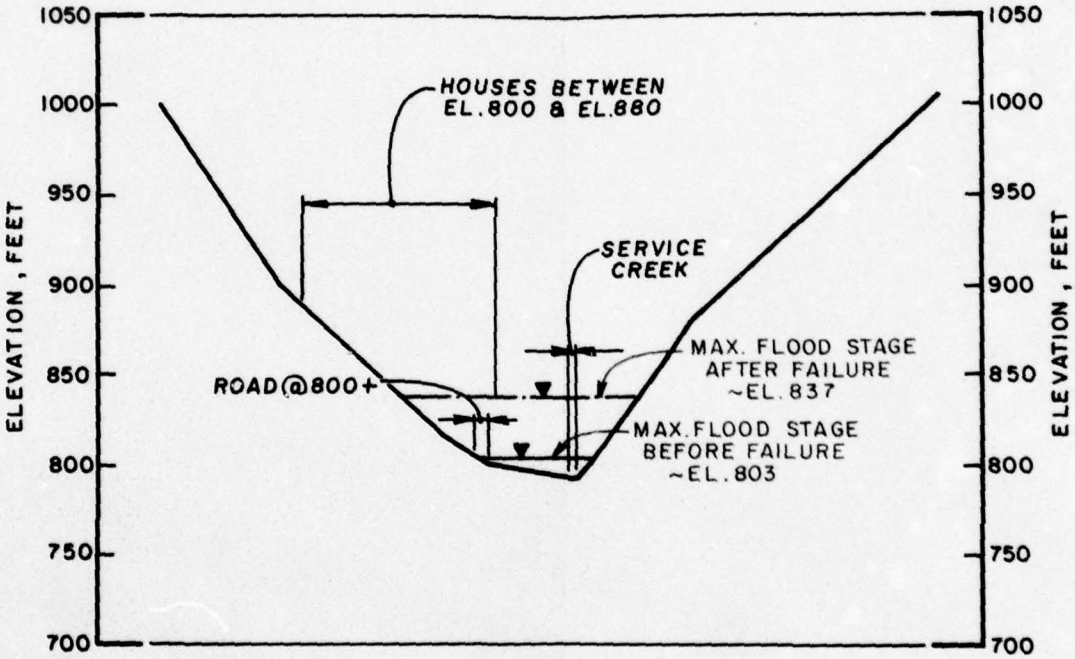
J.C. BACON DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: DEC. 14, 1978

D'APPOLONIA


DRAWN BY ACS 4-18-79
CHECKED BY RC 4-11-79
APPROVED BY AHP 4-17-79
DRAWING NUMBER 78-367-B112
N
RACCOON
Green Garden
BM 1190
PIPE LINE
Frames Run
SHOPPING CENTER
RACCOON CREEK
SERVICE CREEK
STATION ① (RESERVOIR)
STATION ② (DAM)
STATION ③ (SECTION)
STATION ④ (SECTION)
PIPELINE
REFERENCE:
U.S.G.S 7.5' ALIQUIPPA, PA. QUADRANGLE
PHOTOREVISED 1969, SCALE 1:24000
SCALE
0 1000 2000 3000 4000 FEET
ELEVATION, FEET
NOTE:



SECTION @ STATION ③



SECTION @ STATION ④

HORIZONTAL SCALE

0 400 800 FEET

NOTE:

SECTIONS WERE DEVELOPED FROM U.S.G.S. TOPOGRAPHY AND ARE ONLY APPROXIMATE.

PLATE 9

D'APPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM J. C. Bacon Dam COUNTY Beaver STATE Pennsylvania NDI ID PA-260
ID# DER ID 4-42

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION December 14, 1978 WEATHER Sunny TEMPERATURE 40s

POOL ELEVATION AT TIME OF INSPECTION 935.2 M.S.L. TAILWATER AT TIME OF INSPECTION 852.3 M.S.L.

INSPECTION PERSONNEL:

Bilgin Erel

Wah-Tak Chan

REVIEW INSPECTION PERSONNEL:
(December 20, 1978)
E. D'Appolonia
L. D. Andersen
J. H. Poellot
B. Erel

Bilgin Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	An erosion ditch on the right abutment embankment interface. Erosion ditch extends from midheight of the embankment to toe level.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Middle one-third of the crest is about 1 to 1.2 feet below design elevation relative to the spillway crest level.	Crest should be surveyed and low spots should be filled.
RIPRAP FAILURES	None.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Swampy areas at the junction of the embankment with both abutments. See Plate 8 for the location of swampy areas.	
ANY NOTICEABLE SEEPAGE	Numerous seeps below the toe and at the junction of the embankment with the right abutment. See Plate 8 for the location and estimated quantity of seepage holes.	Seepage flows should be monitored and seepage areas should be periodically inspected to document if seepage flows are increasing.
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduit is not accessible. Only the downstream end is visible. No distress was observed.	
INTAKE STRUCTURE	Submerged. Not visible.	
OUTLET STRUCTURE	Outlet conduit would discharge into a plunge pool.	
OUTLET CHANNEL	There are several boulders at the discharge end of the outlet conduit that may obstruct the flow through the outlet conduit.	The boulders at the discharge end of the outlet conduit should be removed.
EMERGENCY GATE	The water company personnel reported that the outlet conduit sluice gate has not been operated since the construction of the dam.	Operational condition of the outlet conduit gate should be evaluated and necessary maintenance performed.

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	150-foot-wide concrete overflow section. Overflow section is partially obstructed by debris in the approach channel.	
APPROACH CHANNEL	Approach channel is partially obstructed with debris and siltation.	The debris and silt in the approach channel should be cleaned.
DISCHARGE CHANNEL	Rectangular concrete channel. In good condition.	
BRIDGE AND PIERS	None.	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A.	
APPROACH CHANNEL	N/A.	
DISCHARGE CHANNEL	N/A.	
BRIDGE PIERS	N/A.	
GATES AND OPERATION EQUIPMENT	N/A.	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderately steep. No significant shoreline erosion.	
SEDIMENTATION	Unknown.	
UPSTREAM RESERVOIRS	None.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are no obstructions that would affect the discharge capacity of the spillway.	
SLOPES	No apparent instability (immediately downstream from the dam.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	There are approximately eight homes in the Service Creek valley within the potential flood plain. A major shopping center is located approximately three miles downstream from the dam in the Raccoon Creek valley. Population: Over 100.	

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
AND HYDROLOGIC AND HYDRAULIC
PHASE I

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM J. C. Bacon Dam
ID# NDI I.D. No. PA-260
DER I.D. No. 4-42

ITEM	REMARKS
AS-BUILT DRAWINGS	The design drawings are available in state files.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed by The Chester Engineers of Pittsburgh, Pennsylvania, from 1953 to 1955. The dam was constructed by D. W. Winkelman Company, with completion in November 1956.
TYPICAL SECTIONS OF DAM	See Plate 3.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See Plates 6 and 7.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not available.
DESIGN REPORTS	Subsurface investigation report prepared by Foundation Associates, Inc., of Pittsburgh, Pennsylvania, dated March 28, 1955.
GEOLOGY REPORTS	Subsurface investigation report prepared by Foundation Associates, Inc., of Pittsburgh, Pennsylvania, dated March 28, 1955.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	The results of embankment stability calculations are included in Foundation Associates report. The results of hydrologic and hydraulic analyses are included in a state report entitled, Report Upon the Application of Borough of Ambridge Water Authority, dated April 7, 1955.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	See Plates 3 and 4.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported.
BORROW SOURCES	Borrow sources are described in the Foundation Associates, Inc. report.
MONITORING SYSTEMS	None.
MODIFICATIONS	None reported.
HIGH POOL RECORDS	Not recorded. According to Ambridge Water Authority personnel, the highest pool level was approximately 1 foot above the spillway crest.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	Not available.
SPILLWAY PLAN SECTIONS DETAILS	See Plate 5.
OPERATING EQUIPMENT PLANS AND DETAILS	See Plate 7.

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 15.7 square miles (wood and pastureland)

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 935 (10,860 acre-feet)

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 945 (15,100 acre-feet)

ELEVATION; MAXIMUM DESIGN POOL: 945

ELEVATION; TOP DAM: 945 as designed, 943.8 (measured low spot)

SPILLWAY:

a. Elevation 935

b. Type Concrete overflow section

c. Width 115 feet (perpendicular to flow)

d. Length Not applicable

e. Location Spillover Middle one-third length of the embankment

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 5-foot by 5-foot reinforced concrete conduit

b. Location At center of embankment

c. Entrance Inverts 855.3

d. Exit Inverts 850.2

e. Emergency Draindown Facilities Outlet conduit sluice gate

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NONDAMAGING DISCHARGE: Spillway capacity

APPENDIX C

PHOTOGRAPHS

LIST OF PHOTOGRAPHS
J. C. BACON DAM
NDI I.D. NO. PA-260
DECEMBER 14, 1978

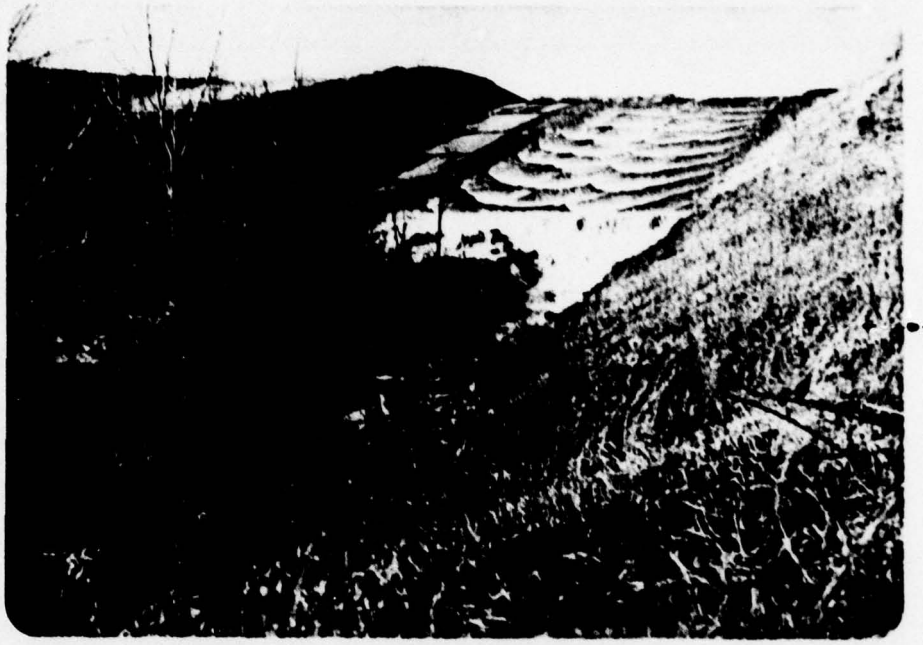
PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking north).
2	Spillway.
3	Spillway crest. Note debris at crest.
4	Spillway discharge channel.
5	Intake tower.
6	Blow-off conduit. Note rock in the outlet structure.
7	Boil on left abutment at toe level.
8	Seepage stream at the junction of embankment and right abutment.

Photograph No. 1

Crest (looking north).

Photograph No. 2

Spillway.

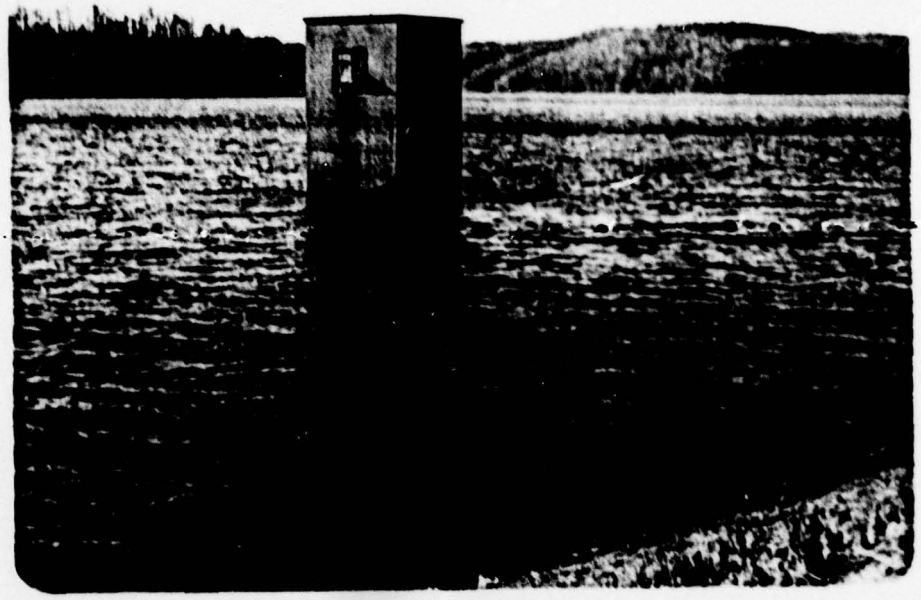


Photograph No. 3

Spillway crest. Note debris at crest.

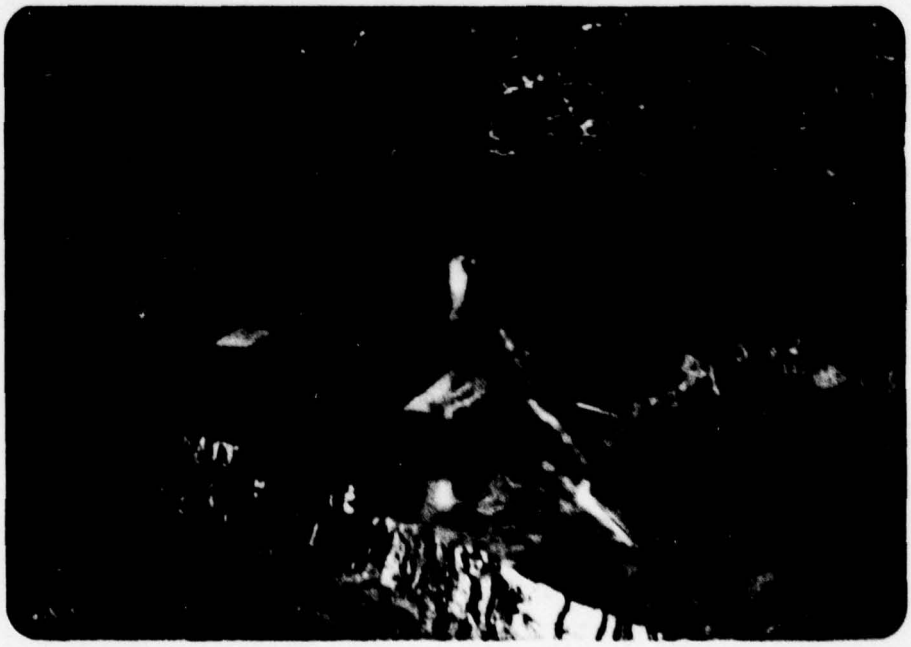
Photograph No. 4

Spillway discharge channel.



Photograph No. 5

Intake tower.



Photograph No. 6

Blow-off conduit. Note rock in the outlet structure.

Photograph No. 7

Boil on left abutment at toe level.

Photograph No. 8

Seepage stream at the junction of embankment and right abutment.

APPENDIX D
CALCULATIONS

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: J. C. Bacon (NDI I.D. PA-260)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 24.0 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	Service Creek Reservoir	J. C. Bacon Dam			
Drainage Area (square miles)	15.4	0			
Cumulative Drainage Area (square miles)	15.4	15.4			
Adjustment of PMF for Drainage Area (%)[2]					
6 Hours	98	-			
12 Hours	116	-			
24 Hours	126	-			
48 Hours	136	-			
72 Hours	-	-			
Snyder Hydrograph Parameters					
Zone[3]	28	-			
C_p/C_t[4]	0.57/1.7	-			
L (miles)[5]	3.8	-			
L_{ca} (miles)[5]	0.3	-			
$t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours)	1.8	-			
Spillway Data					
Crest Length (ft)	-	115			
Freeboard (ft)	-	8.8			
Discharge Coefficient	-	3.1			
Exponent	-	1.5			

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1                A1      SNYDER UNIT HYDROGRAPH,FLOOD ROUTING   DAM OVERTOPPING ANALYSES
    2                A2      J.C.BACON DAM,BEAVER COUNTY,ND1-ID.PA.260                PROJECT NO.78-367-14
    3                A3      FOR 20%,30%,40%,50%,60%,70%,80%,90%,AND 100% PMF
    4                Q    300         0        10         0         0         0         0         0        -4         0
    5                J1     5
    6                J      1         9         1
    7                J1  0.20      0.30      0.40      0.50      0.60      0.70      0.80      0.90      1.00
    8                K      9         1                                              1
    9                K1      CALCULATION OF INFLOW HYDROGRAPH TO SERVICE CREEK RESERVOIR(J.C.BACON)
   10                M      1         1      15.4                 15.4                                        1
   11                P               24.0        98       116       126       136
   12                T                                                                 1.0       .05                0.0424
   13                J   1.77      .57
   14                X   -1.0     -0.05       2.0
   15                K      1         2                                              1
   16                K1      ROUTING FLOW THROUGH J.C.BACON DAM,ND1-ID.PA260(SERVICE CREEK RESERVOIR)
   17                Y                                          1         1
   18                Y1     1                                                  10863.0
   19                SS   0.0 10863.0 15112.0 21793.0
   20                SE 857.0   935.0   945.0   960.0
   21                SS 935.0   115.0    3.08     1.5
   22                SD943.80     3.08     1.5  1000.0
   23                SL 200.0   400.0   500.0   600.0   700.0   750.0   850.0   950.0  1000.0
   24                SV943.80  943.85  943.90  944.00  944.05  944.15  944.40  944.45  944.85
   25                K     99
```

COMPUTER INPUT: OVERTOPPING ANALYSIS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	*	15.40	1	7641.	11461.	15282.	19102.	22922.	26743.	30563.	34383.	38204.
	(	39.89)	(	216.36)(	324.54)(	432.72)(	540.91)(	649.09)(	757.27)(	865.45)(	973.63)(	1081.81)
ROUTED TO	*	15.40	1	3787.	6214.	8784.	13143.	17958.	22496.	26831.	31029.	35138.
	(	39.89)	(	107.23)(	175.96)(	248.74)(	372.16)(	508.53)(	637.01)(	759.77)(	878.66)(	994.99)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	935.00	935.00	943.80
STORAGE	10863.	10863.	14602.
OUTFLOW	0.	0.	9246.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.2	939.85	0.00	12925.	3787.	0.00	44.00	0.00
.3	941.75	0.00	13732.	6214.	0.00	43.67	0.00
.4	943.50	0.00	14476.	8784.	0.00	43.67	0.00
.5	944.81	1.01	15031.	13143.	3.17	43.17	0.00
.6	945.54	1.74	15351.	17958.	4.33	42.67	0.00
.7	946.11	2.31	15605.	22496.	5.17	42.50	0.00
.8	946.60	2.80	15823.	26831.	5.83	42.17	0.00
.9	947.04	3.24	16019.	31129.	6.33	42.17	0.00
1.00	947.44	3.64	16199.	35138.	7.00	42.00	0.00

OVERTOPPING ANALYSIS SUMMARY

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	935.00	935.00	943.80
STORAGE	10863.	10863.	14602.
OUTFLOW	0.	0.	9246.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.4[illegible]	943.5[illegible]	0.00	14476.	8784.	0.00	43.67	0.00
.45	944.29	.49	14805.	10589.	2.33	43.50	0.00
.5	944.81	1.01	15031.	13143.	3.17	43.17	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	8779.	832.8	43.67
.45	10594.	833.9	43.50
.50	13117.	834.8	43.17

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	8719.	800.4	44.00
.45	10438.	802.0	43.83
.50	13030.	803.4	43.50

BREACH ANALYSIS STEP 1: FLOOD STAGES BEFORE DAM FAILURE

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION   26 FEB 79
**********
    1                 A1       SNYDER UNIT HYDROGRAPH,FLOOD ROUTING,DAM OVERTOPPING AND BREACH ANALYSES
    2                 A2       J.C.BACON DAM,BEAVER COUNTY,NDI-ID.PA.260                PROJECT NO.78-367-14
    3                 A3       FOR 47%,45% AND 51% PMF
    4                 H     300        0       10        0        0        0        0        0       -4        0
    5                 B1      5
    6                 J       1        3        1
    7                 J1   1.40     0.45     0.50
    8                 K       0        1                                                  1
    9                 K1       CALCULATION OF INFLOW HYDROGRAPH TO SERVICE CREEK RESERVOIR(J.C.BACON)
   10                 M       1        1     15.4               15.4                                        1
   11                 P               24.0       93      116      126      136
   12                 I                                                             1.0      .05            0.0424
   13                 J    1.77     0.57
   14                 X    -1.0    -0.05      2.0
   15                 K       1        2                                                  1
   16                 K1       ROUTING FLOW THROUGH J.C.BACON DAM,NDI-ID.PA260(SERVICE CREEK RESERVOIR)
   17                 V                                 1        1
   18                 V1      1                                                 10865.0
   19                 SS      0.0 10863.0 15112.0 21723.0
   20                 SE  957.0    935.0    945.0    963.0
   21                 SS  935.0    115.0     3.08      1.5
   22                 SD  943.8     3.08      1.5   1000.0
   23                 SL  200.0    400.0    500.0    600.0    700.0    750.0    850.0    950.0   1000.0
   24                 SV943.85   943.85   943.90   944.00   944.05   944.15   944.40   944.45   944.85
   25                 SA  300.0        1   868.8        0.5   935.0   944.5
   26                 K       1        3                                                  1
   27                 K1       CHANNEL ROUTING USING MODIFIED PULS,REACH 2 TO 3 (POTENTIAL DAMAGE APEA)
   28                 V                                 1        1
   29                 V1      1
   30                 V6   0.04     0.05     0.04    821.0    940.0   4030.0  0.00816
   31                 V7    0.0    940.0     50.0    900.0    150.0    821.0    160.0    821.0    350.0    840.0
   32                 V7  900.0    860.0   1150.0     88 .0   1250.0    900.0   1500.0    920.0   1800.0    940.0
   33                 K       1        4                                                  1
   34                 K1       CHANNEL ROUTING USING MODIFIED PULS,REACH 3 TO 4 (POTENTIAL DAMAGE AREA)
   35                 V                                 1        1
   36                 V1      1
   37                 V6   0.04     0.05     0.04    792.0   1000.0   7900.0  0.00367
   38                 V7    0.0   1000.0    250.0    900.0    600.0    820.0    720.0    800.0    890.0    792.0
   39                 V7  900.0    792.0    920.0    800.0   1100.0    860.0   1150.0     88 .0   1700.0   1000.0
   40                 K      99
```

COMPUTER INPUT: BREACH ANALYSIS STEP 2

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .40	RATIO 2 .45	RATIO 3 .50
HYDROGRAPH AT	1	15.40	1	15282.	17192.	19102.
	(	39.89)	(	432.72)(	486.82)(	540.91)(
ROUTED TO	2	15.40	1	8784.	10588.	291159.
	(	39.89)	(	248.74)(	299.82)(	8244.71)(
ROUTED TO	4	15.40	1	8779.	10583.	309277.
	(	39.89)	(	248.59)(	299.68)(	8757.74)(
ROUTED TO	6	15.40	1	8719.	10437.	27[illegible].
	(	39.89)	(	246.90)(	295.55)(	766[illegible].55)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	935.00	935.00	943.80
STORAGE	10843.	10863.	14472.
OUTFLOW	0.	0.	9746.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.40	943.57	0.00	14476.	8784.	0.00	43.67	0.00
.45	944.29	.48	14805.	11588.	2.33	43.50	0.00
.50	944.43	.63	14871.	320696.	.62	42.71	42.33

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	4779.	832.8	43.67
.45	10593.	833.9	43.50
.50	309277.	864.0	42.83

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	8719.	800.4	44.00
.45	10437.	802.0	43.83
.50	271530.	837.0	42.83

BREACH ANALYSIS SUMMARY: STEP 2

APPENDIX E

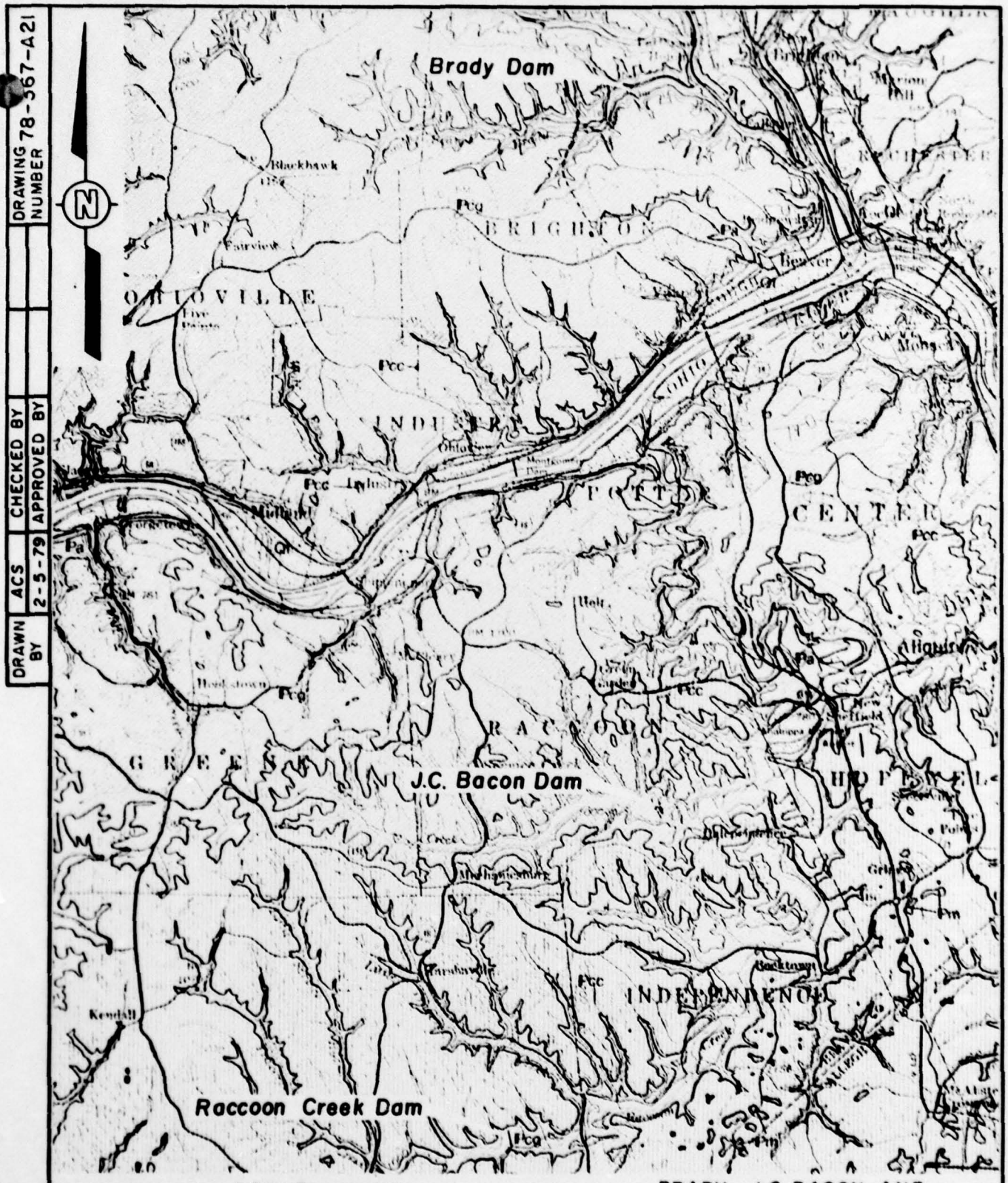
REGIONAL GEOLOGY

APPENDIX E
REGIONAL GEOLOGY

The J. C. Bacon Dam is located on rock strata of the Lower Conemaugh Group (Pennsylvanian Age) consisting primarily of sandstone and shale beds with minor claystone and coal seams. The geologic structure consists primarily of gentle domes and basins, with the rock strata in the vicinity of the dam dipping approximately 60 feet per mile to the south-southeast.

The rock in the slopes above the dam consists predominantly of shale and claystone. The strata below the reservoir is the Mahoning Sandstone, consisting of interbedded gray sandstone and gray and red shale. The Mahoning coal seam, also referred to as the East Palestine coal, occurs approximately 30 to 50 feet below the reservoir. This coal seam is two feet thick or less and has been mined locally for house coal. The Upper Freeport coal seam occurs approximately 100 feet below the reservoir. None of the coal seams have been mined in the dam area.

The slopes above the reservoir are relatively steep on the north side of the reservoir and may have shallow sliding and slumping occurring. These slides should not be large enough to reduce the volume of the reservoir.


Brady Dam
J.C. Bacon Dam
Raccoon Creek Dam
DRAWN BY ACS 2-5-79
CHECKED BY
APPROVED BY
DRAWING NUMBER 78-367-A21
N
SCALE
0 1 2 3 4 5 miles
BRADY, J.C. BACON AND RACCOON CREEK DAMS
GEOLOGY MAP
REFERENCE
GREATER PITTSBURGH REGION GEOLOGIC MAP
COMPILED BY W.R. WAGNER, J.L. CRAFT, L. HEYMAN
AND J.A. HARPER, DATED 1975, SCALE 1:125000

DRAWN BY	ACS	2-5-79
CHECKED BY	BE	2-6-79
APPROVED BY	[illegible]	2-8-79

DRAWING NUMBER 367-A22

GROUP	FORMATION		DESCRIPTION
	Alluvium	Qt	Sand, gravel, clay.
	Terrace deposits		Sand, clay, gravel on terraces above present rivers; includes Carmichaels Formation.
DUNKARD	Greene		Cyclic sequences of sandstone, shale, red beds, thin limestones and coals.
DUNKARD	Washington	Pw	Cyclic sequences of sandstone, shale, limestone, and coal; contains Washington coal bed at base.
DUNKARD	Waynesburg		Cyclic sequences of sandstone, shale, limestone and coal; contains Waynesburg coal bed at base.
MONONGAHELA		Pm	Cyclic sequences of shale, limestone, sandstone and coal; contains Pittsburgh coal bed at base.
P: CONEMAUGH	Casselman	Pcc	Cyclic sequence of sandstone, shale, red beds and thin limestone and coal.
P: CONEMAUGH	Ames		
P: CONEMAUGH	Glenshaw	Pcg	Cyclic sequences of sandstone, shale, red beds and thin limestone and coal; several fossiliferous limestone; Ames limestone bed at top.
ALLEGHENY	Vanport	Pa	Cyclic sequences of shale, sandstone, limestone, and coal; contains Brookville coal at base and Upper Freeport coal at top; within group are the commercial Vanport limestone and Kittanning and Clarion coals.

GEOLOGY MAP LEGEND

REFERENCE:

GREATER PITTSBURGH REGION GEOLOGIC MAP
COMPILED BY W.R. WAGNER, J.L. CRAFT, L. HEYMAN
AND J.A. HARPER, DATED 1975, SCALE 1:125000